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AND ITS ENVIRONS

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STARVED ROCK STATE PARK
AND ITS ENVIRONS

By
CARL O. SAUER
GILBERT H. CADY
AND
HENRY C. COWLES

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FOREWORD

This Bulletin has been prepared for the benefit of those who, in their visits to Starved Rock State Park, are interested in knowing more about the region than can be gathered by personal observation in the few hours, or the few days, commonly spent in the park. The authors of the several parts of the volume have given much time to the study of those phases of the region which they severally discuss. The chief interest of the Geographic Society centers in the geography of the region. The physical geography of the park and its surroundings has a number of features, such as the beautiful little canyons, which are somewhat unusual in this part of the country. Physical geography has its basis in geology, and plant life is closely related to topography and to conditions of moisture, soil, and sunlight. In addition to a discussion of the geography, therefore, it has seemed appropriate to present a brief outline of the geology of the region, and to give some account of the plant life as related to its physical surroundings.

One phase of modern geography is historical, and the author of Part I has given some account of the historical development of the region, especially in its relation to physical environment. The historical statement has gone beyond the strict limits of geography, but not beyond the limits which seem appropriate in this Bulletin. The history leads to a consideration of human activities in the region at the present time, and of their relations to the physical environment. This human phase of the subject may be of interest to some to whom physical features do not make a strong appeal.

It is especially fitting that this Bulletin is published by the Geographic Society of Chicago, since this Society was one of the prime movers in the establishment of the park. Through a committee, of which W. F. Rocheleau was chairman, the Society took an active part in securing the passage of the Illinois Park Commission Bill, and after the bill was passed was represented by Professor Wallace W. Atwood, then of the University of Chicago, on the commission appointed under it. The Starved Rock State Park became a fact after the report of that commission.

The gratitude of the Society is due to the authors—Dr. Sauer, now of the University of Michigan; Dr. Cady, of the Illinois State Geological

Survey; and Professor Cowles, of the University of Chicago—for their several contributions, which have been made without expense to the Society. The compensation of the authors must come from the gratitude of those who use the volume. If it shall prove that they have helped others to see, to understand, and to appreciate, they will feel repaid for their work.

The Geological Survey of the state, ever mindful of the interests of the citizens of the state, has generously furnished the topographic and geologic maps which accompany the volume, and has, from the beginning, encouraged in every way the preparation of the volume.

ROLLIN D. SALISBURY

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CARL O. SAUER

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SURFACE FEATURES AND THEIR ORIGIN

TOPOGRAPHY

THE ILLINOIS RIVER

From the earliest days Starved Rock has been the best-known feature of the Illinois Valley. History and legend connect it with the Illinois Indians, at one time lords of the stream and of a large surrounding region. French adventurers, using the Illinois River in passing between the Great Lakes and the Mississippi River, early admired its rugged charm and later availed themselves of its strong defenses. Today the old trail of the Illinois has become a great highway, used by an ever-increasing stream of visitors, who come from city and farm to Starved Rock, now included in a park belonging to the people of Illinois.

The story of Starved Rock is a chapter from the history of the Illinois River. It had its origin in the erosion of the valley. When man came to the Illinois region, Starved Rock became a landmark in the history of the Illinois basin. In relating the story of Starved Rock it is necessary, therefore, to take into account the larger region to which it belongs.

The Illinois River system drains about 32,000 square miles, situated mostly within the state to which it has given its name. From the place where the Kankakee and Des Plaines rivers unite to form its beginning the Illinois flows about 275 miles to its junction with the Mississippi. Approximately 42 miles below the source and almost opposite the village of Utica is Starved Rock. A few miles below, the Big and Little Vermilion rivers join the Illinois. Looking upstream from Starved Rock a

similar feature, Buffalo Rock, hides from sight the mouth of the Fox River, one of the largest and longest affluents of the Illinois. The position of Starved Rock in the Illinois Valley is shown in Fig. 1.

The flow of the upper Illinois River is disturbed by numerous rapids. The largest of these is at Marseilles; the lowermost is at the base of Starved Rock. From its source to Starved Rock the river has a fall of

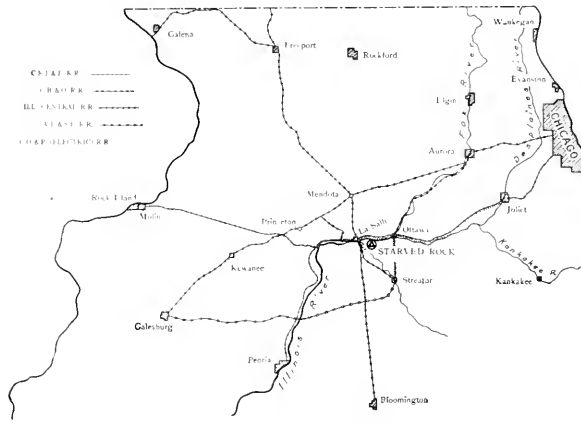

FIG. 1.—Map showing location of Starved Rock State Park and principal railroad lines by which it may be reached. Starved Rock is not on any railroad but may be reached conveniently from the Utica station of Chicago, Rock Island & Pacific R.R., from which it is nearly three miles distant, or by ferry from the Starved Rock station of the Chicago, Ottawa & Peoria (electric) R.R. The electric line has frequent service to Ottawa, La Salle, Princeton, Bureau, Streator, and Joliet, and enables connections with steam railroads at these points.

47.2 feet, or more than 13 inches per mile. From Starved Rock to its mouth, nearly 230 miles, the total fall of the river is only 27.7 feet, or less than $1\frac{1}{2}$ inches per mile. Above Starved Rock the Illinois in its natural condition is almost without value for navigation, but capable of developing valuable power. Below, the conditions are reversed, and the even, gentle current has long been made to bear a varied traffic. The head of practicable navigation, however, has not been at Starved Rock, but at La Salle-Peru. At their mouths the Vermilion rivers have

built large bars out into the Illinois, and these have proved such serious obstructions that ordinarily boats have not passed above them.

Like most prairie streams, the Illinois has a very uneven flow. The average discharge at Starved Rock is 2,400 cubic feet per second, but in summers past the stream has often dwindled to one-fourth its normal volume. At shoal places it could then be forded easily. At such times the shrunken river became fouled with the sewage of upriver towns. At other times floods swell the stream, which then frequently discharges

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FIG. 2.—View down the Illinois Valley from Starved Rock

five or six times the normal volume of water. Occasionally a great flood inundates all the low bottoms and spreads beyond them. Such a flood occurred in 1892 when 93,600 cubic feet per second flowed past La Salle. Fig. 2 is a view down the Illinois from Starved Rock with the river at normal water stage. Fig. 3 was taken in nearly the same place with the stream inundating the bottom fields. In a region of such slight relief this inequality of flow appears at first sight extraordinary; but the basin of the Illinois is, for the most part, without the natural features which arrest run-off; wooded slopes are few, and most of the land is cultivated. Corn is the most important crop, occupying one-third to one-half of all farmed land. As a result the soil cover is scanty and presents few obstacles to the run-off. Again, the soil and subsoil are dominantly clayey, and into such material rain water does not sink readily. Much

of it, therefore, flows off over the surface and quickly gets into the streams. In winter quantities of snow and ice accumulate and in many cases melt rapidly at the approach of spring. Rainfall is irregular and often comes in heavy downpours. All of these factors contribute to the uneven flow of the Illinois River.

Since the completion of Chicago's drainage canal, a sufficient quantity of water has been diverted from Lake Michigan to maintain a vigorous flow in the Illinois irrespective of variations of rainfall and of run-off.

G. D. Fuller

FIG. 3.—View down the Illinois Valley from Starved Rock at high water

FEATURES OF THE ILLINOIS VALLEY

Starved Rock and similar features.—Within the valley, between Ottawa and La Salle, are a number of rock masses almost as high as the river bluffs and more or less detached from them. The largest of these is Buffalo Rock, several miles below Ottawa. Others are Starved Rock and Split Rock on the north side of the valley near La Salle. Of these Starved Rock and Buffalo Rock are most isolated. Starved Rock (Fig. 4) juts out prominently into the Illinois River. It has the outline of the figure 8, one arc forming Starved Rock proper and the other elevation lying to the south, separated from the main rock by a low, narrow saddle. Fig. 5 shows both parts of Starved Rock, viewed from Lover's Leap. The sides of the rock (Fig. 4) are cliffs of bare sandstone, except where crevices and narrow ledges have permitted a bit of soil to accumulate. In such places and on the top of the rock vegetation has gained a foothold. The saddle on the south provides easy access to the summit, but at other places it may be scaled only with difficulty.

Valley floor.—No point of vantage affords a better view of the valley than the top of Starved Rock. From here the broad trough of the Illinois may be seen stretching east to Buffalo Rock and west to the smoke-dimmed horizon at La Salle (Fig. 2). The valley averages a mile to a mile and a half in width. Between Ottawa and La Salle the river flows close to the southern side of its valley, except near Covel Creek; most of the valley flat is therefore north of the river. In the stream there lies a chain of narrow, tree-bordered islands, subject to overflow and of high fertility.

Ira B. Meiers

FIG. 4.—Starved Rock

The floor of the valley varies greatly both in the nature of its surface and of its soil. From a point slightly below Utica to the mouth of the river the valley floor is in general a flood-plain, subject to overflow (Fig. 3) and still largely not reclaimed. Many of these bottom tracts are permanently wet and sloughs are numerous. The valley above Utica is of a different type. Here the area of low bottom land is small and is confined to the islands and to a narrow strip along the river. Opposite Starved Rock there is such a stretch of fertile flood-plain. Below Starved Rock a strip of low or "first bottom" land lies along the south bank of the river within the State Park and surrounds Starved Rock and Lost "lakes." Fig. 6 shows the contact between river flood-plain and river bluffs and at the right a portion of a slough bordered by

willow, ash, and elm. The view is taken at the entrance to the park. Most of the valley bottom about Starved Rock is a terrace from 25 to 40 feet above the normal level of the river. Its surface is somewhat uneven and its soils diverse. Deserted river channels form long and sinuous depressions, in which the material may range from silt to gravel. Between the depressions are short ridges, some of which are sandy or gravelly, while others consist of rock thinly veneered with soil. The land is said to "lie in strips," fields of high fertility being adjacent to rocky pastures that produce only a scant growth of grass.

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FIG. 5.—Starved Rock from the landward side. Pines occur on the exposed crags and oaks on the slopes.

Valley slopes—bluffs.—As one approaches Starved Rock from either upstream or downstream the sides of the valley become more and more steep. From the head of the Illinois River to Starved Rock they increase in height as well. The city of Morris is in a low basin, with scarcely perceptible slopes; at Seneca the valley has well-defined sides, which, however, are sufficiently gentle to be used for pasturage; near Ottawa bed rock is seen only here and there, and most of the slope is covered with timber. Below Ottawa low cliffs appear at the bases of the slopes, and these become higher and higher downstream until at Starved Rock the sides of the valley are for the most part cliffs of rock. Fig. 7 shows typical cross-sections of the upper valley at the four principal cities. Below Starved Rock the rock cliffs continue at about the same elevation almost to the Vermilion rivers. Here they are replaced rather

abruptly by slopes which are still steep but have few rock outcrops (La Salle and Peru in Fig. 7). Well-defined bluffs of rock on the Illinois, therefore, are confined to a narrow belt centering about Starved Rock. This changing character of valley slope can be appreciated best by approaching Starved Rock from Ottawa by boat or by following the southern bank of the river. The latter way is feasible only on foot,

FIG. 6.—Entrance to Starved Rock State Park from Utica bridge. At the right is a portion of the Illinois flood-plain, with mesophytic flood-plain forest. To the left are pine-clad bluffs.

as the road from Ottawa soon turns to ascend the bluff, and the greater part of the way is by an obscure footpath. In this manner, however, the gradual crescendo of scenic effects is best appreciated and the visitor's eye prepared for the climax of the scenery within the park.

A good view of the cliffs across the valley may be had from Starved Rock. These, however, have been masked to a considerable extent by the accumulation of rock débris, whereas the southern slopes have cleaner and steeper faces because the river washes their bases and has

carried away the detritus which otherwise would have accumulated there. Where narrow remnants of the terrace afford room for tree growth the light-gray cliffs are largely screened by many kinds of trees growing hard against the walls of rock and overhanging the river's edge (Fig. 8). At other places the nearly bare cliffs rise directly above the river (Fig. 9).

Tributary valleys.—Like their main, the tributary streams in the Starved Rock region have developed sheer rock walls. In some of the smaller valleys the height of the cliffs exceeds the width of the valleys.

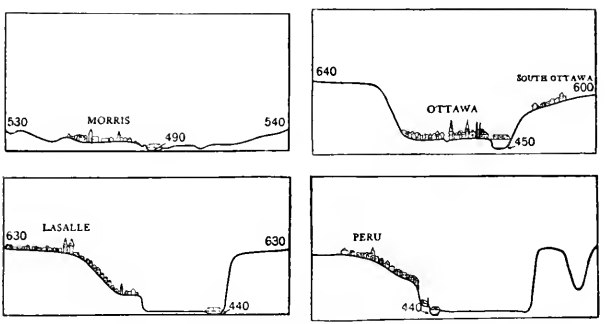

FIG. 7.—Profiles across Illinois Valley at various places, showing changes in nature of valley sides.

These deep and gloomy chasms are fitly called "canyons." Most of the canyons are less than a mile long and contain one or more sharp, angular bends, as, for example, Horseshoe Canyon (see topographic map). Usually they are blunt-headed, ending in falls that average perhaps 50 feet in height (Fig. 10). Above the falls the valley typically continues for a mile or more as a shallow, inconspicuous "draw" of the type common to prairies.

Viewed from within, a typical canyon shows walls of crumbling crenulated sandstone, rising vertically (Fig. 11), in some cases overhanging (Fig. 12). Within their shadows dank, underground waters drip from mossy crevices. At their bases loose sand has accumulated in quantity, forming in many places a pedestal to the cliffs, densely covered with shade-loving vegetation (Fig. 13). The gray, fern-grown cliffs most commonly inclose a narrow strip of irregular floor with miniature

pools and cascades formed by a brooklet during the rainy seasons (Fig. 13). On the lower parts of a number of canyons small flood-plains are forming (Fig. 14). At times ephemeral waterfalls exist at the heads of the canyons, but much of the year the canyons are dry except for a few pools. From above, overhanging trees and shrubs, growing at the strongly sun-lit level of the prairie, look down into the deep shade. The

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FIG. 8.—View upstream from Starved Rock. A representative upland oak forest, with pines on the marginal crags.

sudden turns of the tortuous gorges disclose to the visitor ever-changing and unexpected views, which constitute not the least of the scenic charms of the locality.

Canyon characteristics are also well developed on the Vermilion rivers. The most imposing of all the canyons of the region, Deer Park Glen, is a tributary of the Big Vermilion River. It was long the property of the late Mr. Matthiessen, a public-spirited citizen of La Salle, who for years permitted the public to enjoy its beauties without restraint.

Below the Vermilion the tributaries again become wider and lose in scenic interest. Similarly, toward Ottawa there is a gradual decline of canyon characteristics, corresponding to the decrease in height of the rocky bluffs of the Illinois.

THE PRAIRIE

All diversified features of the river valley, bluffs, and canyons are but minor irregularities in the general upland prairie surface. For

G. D. Fuller

FIG. 9.—Lover's Leap, seen from the water's edge. A representative habitat of the white pine.

scores of miles around Starved Rock the great prairie plains stretch in all directions. The surface of much of northern Illinois is a treeless, nearly level upland, strikingly undifferentiated. In this surface the upper Illinois Valley is a relatively narrow trench, and the valleys of its tributaries are even smaller notches.

The prairie extends literally to the bluffs of the valleys. There is scarcely any transition zone. Fertile cornfields may reach to within a half-dozen steps of a sheer canyon wall. Near the Illinois and its larger tributaries the prairies are gently rolling. At a distance of a few miles they are so smooth that even slight swells and sags are hardly noticeable.

There is a very gradual rise of surface for miles away from the river, but it is too slight to be conspicuous. On the prairie the horizon is a circle,

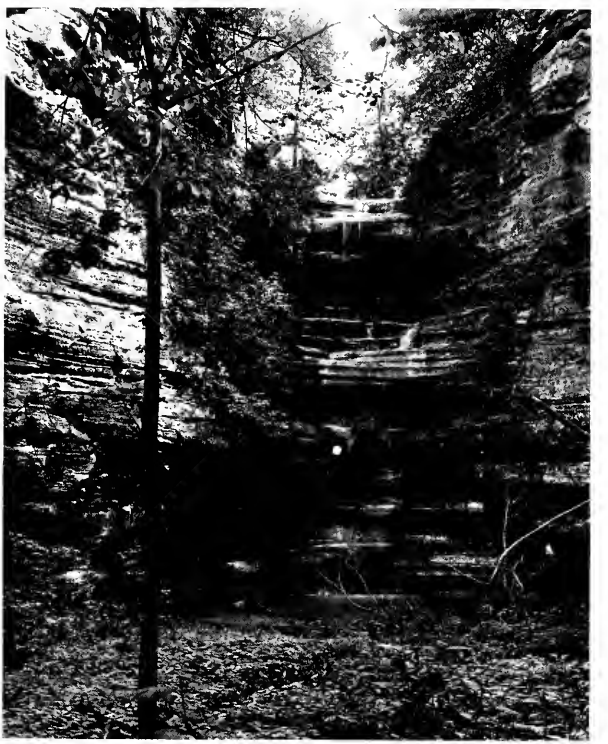

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FIG. 10.—Head of Curtis Canyon, typical of smaller canyons in Starved Rock region.

interrupted only where a line of trees marks a watercourse or where the ample buildings of a farm are outlined against the sky.

ATTRACTIONS OF THE STARVED ROCK REGION

Visitors come to Starved Rock for diverse reasons. The great majority, however, are attracted solely by its scenic features. The

H. Sadroff, Chicago Academy of Sciences

FIG. 11.—View out of French Canyon. The lower slopes are covered with liverworts and mosses, while higher up are mesophytic ferns and seed-plants, including the yew (on wall to right).

expansive panorama of the Illinois Valley is enjoyed from the summit of the rock by almost every visitor. To the city dweller the unspoiled

natural beauty of the park appeals strongly. Probably the principal charm lies in the sharp and unexpected contrast between the level plains and the bare cliffs of rock that form the buttressed mass of Starved Rock and the walls of the narrow canyons. To one sated with the wide hori-

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FIG. 12.—Overhanging side wall in Atwood Canyon, the so-called Atwood Cave. At the left is a heap of sand fallen from the roof.

zontal vistas of the prairies the narrowly confined spaces of the canyons and the towering walls of Starved Rock, surrounded by forest trees, afford a gratifying sense of change and relief. For the visitor who has but a few hours at his disposal there is enough to see in the environs

of Starved Rock to repay a visit; for him who comes in his leisure time scenic charms are scattered liberally for miles along the Illinois

Fig. 13.—Interior of French Canyon. At the base of the cliffs sufficient sandy débris has accumulated to support a rich, shade-loving vegetation.

and Vermilion rivers and invite walks that may be extended almost indefinitely.

INFLUENCE OF BED ROCK ON TOPOGRAPHY

TOPOGRAPHIC EXPRESSION OF THE ANTICLINE

Along the upper Illinois River conspicuous rock cliffs, canyons, and other large outcrops of rock are confined to the region between Ottawa and La Salle. Contiguous to this area are the similar features of the Vermilion and Fox rivers. The only other region of similar character

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FIG. 14.—Lower end of French Canyon, with beginning of flood-plain and very rich mesophytic vegetation.

to be found within scores of miles is on the Rock River in the vicinity of Dixon and Oregon. The peculiarly restricted distribution of these topographic features points to a narrowly localized cause. At Starved Rock and Dixon a domed or anticlinal structure of the bed rock has brought to the surface rock formations that in other parts of northern Illinois are deeply buried. Streams have cut across the anticline and have sunk their channels to considerable depths into the older formations. Some of these rocks are of such a nature as to give rise to canyons and cliffs through erosion.

ST. PETER SANDSTONE

The topography most typical of the region is found associated especially with outcrops of the St. Peter sandstone. Starved Rock and the adjacent canyons are all carved out of this formation. The gradual eastward decline of the bluffs of the Illinois corresponds, in a general way, to the dip of this sandstone, which carries its top beneath the valley a short distance above Ottawa.

The St. Peter formation is a very pure sandstone and in general but little cemented. It is commonly so soft as to be workable with pick and shovel. The workings are not dignified with the name of quarries, but are spoken of as "sand pits," numerously represented on the northern side of the valley along the railroad. Were all of the formation of this prevailing type and without any resistant rock above it erosion would give rise to gentle slopes. Under ordinary conditions the upper part of a slope wears back more rapidly than the lower, and valleys grow wider as time goes on. This normal condition holds good whether the material is soft or hard, so long as it is of uniform resistance. If a–a' (Fig. 15) be the cross-section of a valley at a given period, b–b' should represent the same valley at a later stage. Locally, however, the valleys are box-shaped canyons (1–1′) and retain this form indefinitely (2–2′) without any appreciable reduction in the slope of their sides.

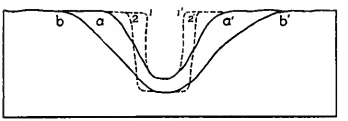

FIG. 15.—Development of valleys in St. Peter sandstone as contrasted with normal development. An early stage of a normal valley is represented by a–a', a later stage by b–b'. In the St. Peter formation 1–1′ represents a similar early stage; 2–2′ a later form

Lying on the soft sandstone is a capping layer of much more resistant rock. This is the more firmly cemented upper portion of the St. Peter sandstone, or, in places, a thin bed of hard Trenton limestone, or the basal sandstone of the "Coal Measures." The combination of hard cap rock and soft underlying bed gives the most favorable condition for the development of cliffs. In Fig. 16, a–a' represents an assumed original slope before erosion commenced; A represents the "Coal Measures" and drift, B the hard cap rock, and C the St. Peter sandstone. The soft sand is worn away readily until the profile b–b' is established. Thereafter the rate of erosion of the softer beds is controlled by the rate of erosion of the cap rock. In this simple statement lies the complete explanation

of the most striking scenic features of the region. If the soft beds are undercut by a stream at their base, or if they are sufficiently weak to weather out under the cap rock, as shown in profile c–c', they in turn will accelerate the wasting of the cap rock. Overhanging cliffs of the latter sort may be seen in many of the canyons, which then appear bottle-shaped in cross-section. The so-called Atwood's Cave of Fig. 12 is an extreme instance of overhang. A large face of the soft sandstone is shown, the friability of which is indicated more particularly by the great heap of fallen sand at the left of the view.

The conditions of Fig. 16 are realized most readily when the profile corresponds to the bed of a stream; B then marks the top of a fall, such

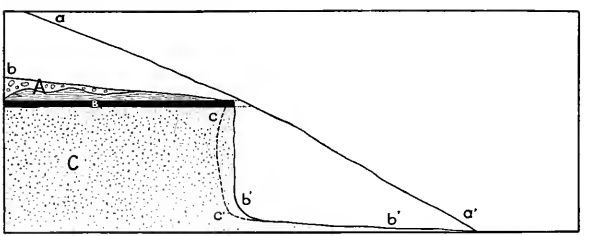

FIG. 16.—Development of cliff face through capping of hard stratum. A is glacial drift underlain by "Coal Measures," B the hard cap rock, and C the main body of St. Peter sandstone. The line a–a' represents an assumed original slope; b–b' and c–c' are slopes resulting from erosion.

as is found at the head of nearly every canyon. As these falls are cut back they leave canyon walls below as records of their recession. The canyons, being of identical origin, are all very similar in pattern, differing chiefly in size.

Wherever a cliff of the St. Peter sandstone is exposed for some time it becomes unevenly corrugated (Figs. 9, 10, 11, 17). Pitted depressions alternate with narrow ridges (Fig. 17). The sandstone is thinly bedded, and weathering is often most rapid along bedding-planes, causing them to form recesses. In places iron oxide has been introduced at the bedding-plane, which has then become more resistant than the body of the rock and weathers into a ridge. Some of the beds of the sandstone are less cemented than others and waste away more rapidly. These contrasts in resistance are not only responsible for the detailed pattern of the cliffs but help greatly to preserve vertical faces in the rock.

Fig. 18 shows numerous cuplike depressions in a cliff at Deer Park Glen. They are arranged like a series of potholes, but are caused by differential weathering. These recesses form both a horizontal and a

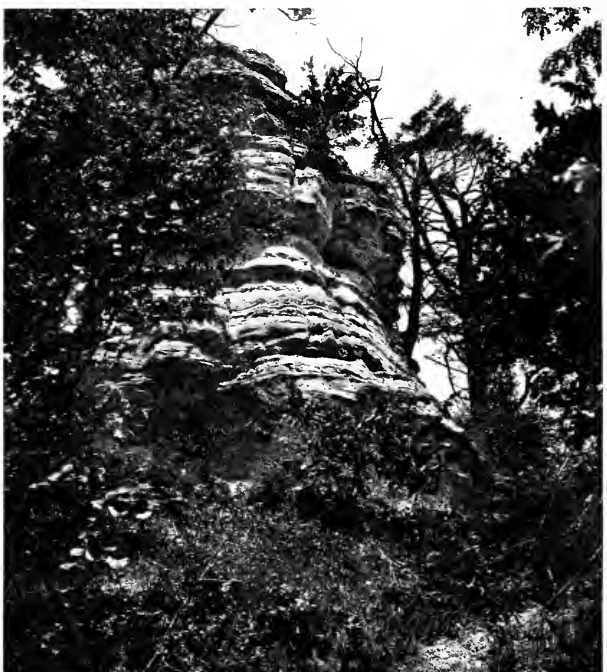

Fig. 17.—The Devil's Nose at Starved Rock, showing sandstone cliff as corrugated by weathering.

vertical series. Their horizontal alignment is caused by the weathering out of a soft bed between harder layers. The vertical arrangement marks the position of joint planes (nearly vertical fissures) which are zones of weakness in the rock.

The St. Peter sandstone is fissured extensively by joints that intersect each other in vertical planes. The most prominent of these joint planes are nearly at right angles to each other. In the stresses to which the region has been subjected during its geologic past the St. Peter formation seems to have cracked more as a rule than the more compact rocks. Every joint plane thus formed is a favored line of attack for

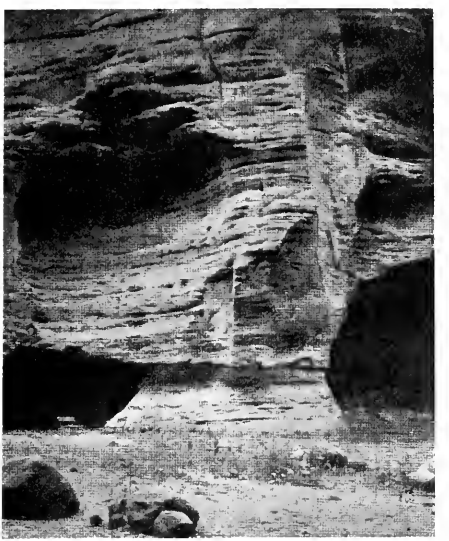

FIG. 18.—Pitted sides of canyon of Deer Park Glen

the agencies of erosion. Joints have hastened the wearing back of the canyons and to a large extent have given direction to their courses. At the head of Horseshoe Canyon, for example, are such joints, along which the stream is working its way back. One of these is shown in Fig. 19. The rectangular turns of some of the canyons, as of Horseshoe and of Deer Park, appear to have been caused by the intersection of two sets of joint planes, as a result of which the streams, in their erosion headward, have been turned aside by the more open fissures.

Starved Rock and the other outlying rock masses find their explanation in the influences of joint planes on erosion. These "rocks" were at one time part of the general upland. The processes by which they

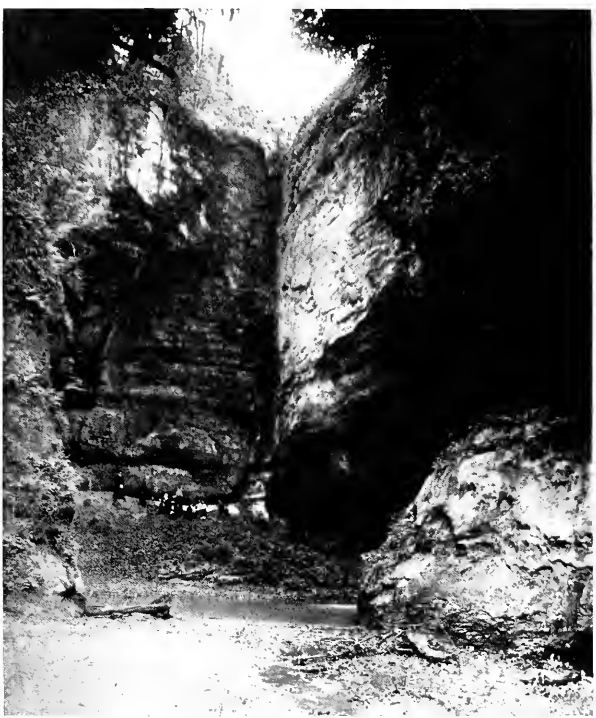

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FIG. 10.—Horseshoe Canyon, showing recession of canyons along joint planes

may have been detached from the bluffs include the following: (*a*) Weathering may have widened joint planes and thus formed recesses similar to the example cited above at Deer Park Glen. (*b*) The river, flowing along the base of a cliff, would tend to cut into the cliff at joints

and thus form re-entrants. (*c*) Glacial stream gravels are found along the valley on the tops of the bluffs. It is known therefore that during some part of the Ice Age a river flowed at the summit level of Starved and Buffalo rocks. This river in time may have cut down several channels along joints, some of which were abandoned later. On this theory the rock masses for a time may have formed true islands. (*d*) Glacial erosion aided in forming the Illinois Valley. The ice moved in a direction parallel to the valley and may have aided in the excavation of the depressions which separate the "rocks" from the main upland. Small bodies of rock may become detached from their surroundings simply by weathering along joint planes; Pulpit Rock, above Lover's Leap, probably originated in this way. Weathering alone may have been responsible as well for the forming of Split Rock near La Salle and of the detached rock mass near the west end of Buffalo Rock. The other rock masses, however, probably are not to be explained in this way. To their development some and perhaps all of the other processes mentioned have contributed.

The rock masses have retained their castellated forms most conspicuously where their bases are washed by the river, as is the case with the northern base of Starved Rock and Lover's Leap. Here the river not only carries away the detritus from the cliffs but is undercutting actively along softer layers (Figs. 4, 9).

PRAIRIE DU CHIEN (LOWER MAGNESIAN) LIMESTONE

The principal outcrops of the Prairie du Chien limestone are north of the river, below Utica. Here to a lesser extent than in the St. Peter sandstone canyons have been formed which resemble those about Starved Rock. The principal gorge in this formation is that of Pecumsaugan Creek, with a depth of more than 80 feet. Here beds of hard limestone, of chert, and of clay and shale alternate irregularly. These various layers offer widely differing resistance to erosion, with a resultant tendency to develop cliffs wherever an incision of some depth has been made.

The massive magnesian limestone beds, where not weakened by the outcrop of softer beds beneath them, withstand erosion perhaps better than any of the other rocks of the region. This formation outcrops at many places in the valley at Utica as well as on the upland to the north. In both of these localities low but well-defined knobs record its successful resistance to degradation.

LA SALLE LIMESTONE

The La Salle limestone outcrops in this vicinity only on the western flank of the anticline, that is, along the Vermilion rivers. Here it has been a factor in the development of gorges. Bailey's Falls, the most notable of the region, have been formed on this limestone. The falls are located on Bailey's Creek, across the river from Deer Park Glen, and some distance upstream. The falls are caused by a somewhat shaly limestone, which underlies a purer, harder, and more massive bed of the same formation.

BEGINNING OF THE PHYSIOGRAPHIC RECORD

BURIED SURFACE OF THE BED ROCK

Rock ledges are to be seen locally only along the larger valleys. Beneath the prairies the bed rock lies many feet underground. Over it is a cover of clay, sand, and gravel, which in many places is more than 200 feet thick. Even along the valleys the lower slopes only, as a rule, disclose ledges of rock. From the meager information available concerning the surface of the bed rock we know that in it are many depressions of great depth and length (buried valleys), and that its highest elevations have a nearly uniform level. If all the clay, sand, and gravel could be stripped from the surface, there would be uncovered a country of even-crested ridges and deep valleys, which would bear in general no resemblance to the present surface.

THE PENEPLAIN

Viewed from Starved Rock the bluffs on all sides (Fig. 2) show a remarkably even sky line. They are made up almost entirely of bedded rock, covered by only a thin layer of loose material. If all the rock outcrops along the valley are examined for some distance above and below Starved Rock, their maximum elevation will be found at about 600 feet above sea-level. Across the whole width of the anticline the bed-rock surface stretches at this nearly uniform elevation across rock formations differing widely in resistance to erosion. In so far as we can judge from well records on the prairie the rock surface is similar. This old, buried rock surface, the crests of which have a nearly uniform elevation, is called a *peneplain*.

DEPRESSIONS IN THE BED ROCK

Here and there along the larger valleys rock outcrops are wanting. Similarly, in places on the prairie, well records show that the bed rock lies at depths far greater than the average. Although no adequate

reconstruction of these depressions is possible at present, fragmental records of a few of them have been compiled. South of Starved Rock, for example, such a depression in the surface of the bed rock, now filled with drift, can be traced for at least 10 miles and apparently is comparable in depth and width to the present Illinois Valley. This depression is not visible from the surface except near Lowell, and is known only from the records of deep wells and other drillings. Farther west, at Princeton, is a buried valley, perhaps as large as that of the Mississippi.

HISTORY OF THE SURFACE OF THE BED ROCK

Between the formation of the last bedded rocks and the deposition of the loose surface materials there was an interval of time which must be reckoned by millions of years. The bedded rocks were laid down far back in the earth's history; the surface materials date back only to the yesterday of geology. The character of the rock surface is the only record we have here of the events that came between.

The rock formations beveled off by the peneplain include the soft St. Peter sandstone and the "Coal Measures" clays and shales, as well as the resistant Prairie du Chien, Trenton, and La Salle limestones. Some of these beds waste away much more readily than others. After a time valleys are formed in the softer rocks while the outcrops of the harder ones constitute ridges. This differentiation continues until the weaker rocks are worn as low as water can bring them. At that time the resistant ridges have their maximum relief. But they too are exposed to the attack of weathering and erosion. Little by little they are reduced, until finally they are brought to the low level of the softer formations. When resistant as well as weak rocks have been worn as low as running water can bring them, the cycle of erosion is complete and the entire region is reduced to a low level called *base level*. A surface that approaches base level is a peneplain. The peneplained surface of the La Salle anticline is the end product of a long-continued period of erosion in which inequalities of resistance were obliterated. Hills had virtually disappeared, and a monotonous plain extended far and wide irrespective of the kind of rock beneath.

After peneplanation an uplift of the land quickened the flow of the streams, and they again set to work cutting down their channels. Erosion seems to have continued long enough in this new cycle to produce larger and more numerous valleys than those of the present surface and was arrested by the invasion of the great continental glacier, which buried the old surface beneath its deposits of drift.

DRIFT

The mantle of loose material that conceals the rock is made up of deposits resulting from glaciation, known collectively as *drift*. Its thickness is independent of the bed-rock surface and is subject to great variations. Within the limits of the park it is at most only a few feet in thickness. On the prairies of La Salle County its average thickness is more than 50 feet. In Miller Township, north of the river, it reaches 250 feet, and near Princeton its thickness locally exceeds 300 feet.

COMPOSITION

Till.—By far the greater part of the local drift is clayey matter, mixed with stones of many sizes and with minor quantities of sand. This is *till* or *bowlder clay*. The clayey matter is rock flour, composed of fine particles of ground-up rock. Its composition is most varied, being determined by the composition of the rock formations from which it was derived. The materials that compose the till are entirely unassorted—sand, small pebbles, and larger bowlders are scattered indiscriminately through a matrix of clay. The till here is more clayey and less stony than that of Wisconsin and of New England. Many of the stones are much larger than a man's head, and here and there one several tons in weight has been exposed in the bed of a stream. At Ottawa a bowlder of unusual size commemorates the local Lincoln-Douglas debate. Other large bowlders may be seen in the bed of the Big Vermilion River.

Most of the bowlders of the till are of limestone of local origin. One reason for this is that there are probably more outcrops of limestone near by than of all other kinds of rock. Another is that the sandstones and shales of the region are too frail to have withstood the tremendous milling to which the ice subjected its material. A goodly minority of the rocks, however, are of igneous or metamorphic origin, schists, trap rock, gabbro, and granite, which are strangers to this country. The nearest place from which they could have been derived is northern Wisconsin, and some of them came from Canada.

The stones of the drift which have broken surfaces and jagged edges are rock fragments, which were torn up, carried a short distance, and then dropped. Their stay in the ice was brief. To this type belong most of the bits of sandstone and shale found in the drift. Much more numerous are the bowlders that have been worn and smoothed to some extent. Most typical of glacial conditions are the bowlders of subangular form, whose sides, or some of them, have been worn flat, and

upon which scratches or striae have been graved. In many cases these stones are also more or less polished by the ice. These subangular bowlders are almost invariably of hard rock, such as compact limestone or some sort of igneous rock.

Because the drift cover along the margins of the Illinois Valley is thin, good exposures of till near Starved Rock are not abundant. Banks of it may be seen along the courses of the tributary streams above the canyons, as above Horseshoe Canyon and on the road between Starved Rock and Deer Park.

Stratified drift.—Stratified drift consists of materials assorted according to size and deposited in more or less definite layers. Gravel is by far the most abundant material of the stratified drift, but there are many beds of coarse sand. Silt and clay are rare in this region. These stratified deposits are only indirectly of glacial origin; they are water-laid deposits, carried out from the ice front and deposited by water formed by the melting of glacial ice. Most of the constituent elements of the gravel and sand are subangular and show little trace of wear by water. They were washed out from the edge of the ice by streams and deposited near by. These outwash materials are in rather regular beds of limited extent. Along the Illinois Valley they range from 20 to 60 feet in thickness. The stratified drift is found principally along the margins of the Illinois Valley and the larger tributaries, such as the Big Vermilion. Its position is on the valley sides high above the valley floor, in some instances extending to the level of the upland adjacent to the valley. Such high-level deposits are numerous north of the river east of Utica. A bed of this type, chiefly gravel, lies on the bluff east of Horseshoe Canyon (Parkman Plain).

Except in the immediate vicinity of the valleys stratified drift is not common at the surface. On the prairies much gravel and sand are buried in the till, forming lens-shaped masses in it. Most of them are of small areal extent and not more than a few feet in thickness, but they are important as water reservoirs for farm wells, as in the case of prairie farms south of the park.

Upland clay.—On the upland most of the soil is formed neither from the till nor from the stratified drift, but from a peculiar clay which may be called the "upland clay" and which overlies the normal drift. It is not a striking feature and escapes attention readily; yet it is of greater direct importance to the prairie farmer than any other deposit. It averages a little more than 3 feet in thickness. Its limits are not defined sharply, but it is confined to the upland. It overlies bed rock, till, and

stratified drift indiscriminately, almost everywhere with a well-defined contact. It lies over all the prairie south of Starved Rock, on the sandstone of the valley bluffs, and possibly forms even the thin cap of soil that supports the vegetation on Starved Rock. Whatever the material beneath, the character of the upland clay remains nearly the same. Its color in most places is brown, and its texture in general very fine and even. The only rocks found in it are bits of chert. On weathering, it forms a heavy, clayey soil of high fertility. Its probable origin is discussed on page 34.

DRIFT TOPOGRAPHY

The prairie derives its topographic character wholly from the drift. As the ice spread its deposits so they remain, in the main, to this day. For the most part the surface discloses no hint of the rock surface beneath. The prairie of La Salle County is a part of the typical till plain or *ground moraine* of north-central Illinois. It is so nearly level that it can scarcely be called undulating. Compared with the ground moraines of more northerly regions it has little topographic expression. Here and there it is crossed by long ridges of drift called *terminal moraines*, which rise a hundred feet or more above the surrounding plain and in this region extend nearly north and south. Such terminal moraines are Farm Ridge, which flanks the east slope of Vermilion Valley south of Starved Rock, and the Marseilles moraine, crossing the Illinois Valley between Marseilles and Ottawa. These terminal moraines are so wide and their slopes so gentle that they are not very conspicuous as ridges.

THE ICE AGE IN NORTHERN ILLINOIS

WORK OF THE ICE—EROSION

During the last geologic epoch ice sheets of continental proportions formed in northern districts. From these centers ice sheets spread in all directions. A great body of ice moved south through the depressions now occupied by Lake Michigan and covered the greater part of Illinois. By this ice sheet the former surface about Starved Rock as well as a much larger area surrounding was buried.

The ice in its advance incorporated into its bottom loose materials and broke off fragments from projecting ledges of rock. In places where it passed over rocky hills it quarried out large quantities of rock. Still other material was taken into the ice as the glacier froze to it. The load which it thus secured the ice carried on by stages, and gradually ground it to powder. Only the hardest rocks survived a long journey,

such as that from Canada to the Illinois Valley. The weaker rocks were crushed to bits if exposed long to glacial wear.

In some sections, as in northern Wisconsin, New England, and Canada, knobs of bare rock, rounded and smoothed, illustrate the wearing down of hills by glacial erosion. In most prairie regions these features are wanting. The amount of erosion may have been great, but its effects have been concealed by the heavy mantle of drift which the ice left. Northwest of Utica rock knolls similar to those of higher latitudes are reproduced in miniature. Here, at the outcrop of the Prairie du Chien limestone on the bluffs, there are rounded bosses of rock smoothed by ice.

The ice stripped off almost all of the old soil, subsoil, and weathered rock which it encountered and even removed much fresh rock. Only in unusually well-sheltered places, as in narrow preglacial depressions, did remnants of the old mantle rock escape erosion. In hard rock the contact between the glacial drift and the underlying rock is sharp and the rock beneath is unweathered. In soft rock the contact is indistinct. On the bluff directly above the Utica bridge are clay pits in which "Coal Measures" clays and coal have been plowed into by the ice and mixed in confused fashion with glacial materials. Most likely the ice ground up and removed a much greater thickness of solid rock than of loose mantle rock. The average thickness of the drift cover is about 50 feet. At least nine-tenths of this is of nearby origin, virtually all of it formed by the grinding up of unweathered rocks. Something like 50 feet of bed rock, therefore, must have been worn away on the average. It is possible that this estimate of the amount of erosion is short of the fact rather than beyond it, as the average thickness of the drift both north and south of the Illinois is much greater than in this immediate vicinity and represents the grinding up of even greater thicknesses of rock.

Scratches and grooves on bed rock near the head of the Illinois Valley show that the direction of ice movement was approximately parallel to the valley. The valley was probably both deepened and widened by the ice which moved westward through it.

WORK OF THE ICE—DEPOSITION

The ice did not transport its load of débris continuously over a great distance. Most of the material was dragged along in the base of the glacier, where melting was more or less constant. Débris probably was being dropped at all times. Much of it was picked up again and carried forward until it found a more or less permanent resting-place at the ice

front where all the ice melted, with the result that its entire load was dropped. When the edge of the ice remained nearly stationary for a long time, well-marked ridges or terminal moraines were formed of débris accumulated beneath it (Fig. 20). In times of decadence the ice edge retreated and, if its recession was fairly uniform, spread its deposits in the form of ground moraine. From place to place the quantity of till deposited varied, so that the surface formed was not even but consisted in general of swells where deposition was heavy and of sags where it was less in amount.

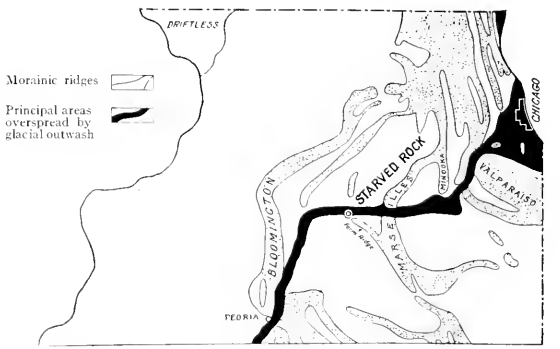


FIG. 20.—Relation of Starved Rock to leading glacial features of northern Illinois

The melting of the ice produced vast quantities of water that spread beyond the ice margin as slope wash, or was gathered into rivers, ponds, or lakes. All of these things happened locally, but in this region glacial streams were most important. They carried great quantities of drift beyond the edge of the ice. Where their flow was most vigorous only gravel was deposited and the sand and clay were swept away. Gravel deposits are typical of the upper Illinois Valley, which was the line of most active drainage.

EARLY INVASIONS OF THE ICE

From facts known to geologists we conclude that this region was covered by ice at least three times, constituting different glacial epochs, which have been called the Kansan, Illinoian, and Wisconsin. To find

local evidence of the older glaciations is, however, a matter of some difficulty. The Wisconsin ice sheet, which covered this region last, stripped away the older deposits in most places and, melting, left a cover of its own drift.

In a few stream-cut banks there may be seen, lying beneath the fresh surface till, another till of strikingly different character. The older drift is thoroughly weathered; its original content of lime carbonate has been leached out for the most part; the bowlders have rotted until they crumble at a blow; and its ferruginous material has rusted and stained the whole a dirty brown. Here and there the older till is separated from the younger by thick beds of gravel, sand, or silt. In the vicinity of Starved Rock such old drift is found abundantly on Cedar Creek south of Peru and in some of the ravines at Marseilles.

WISCONSIN ICE EPOCH

The drift of the last glacial epoch was first studied and identified in Wisconsin, and hence the epoch is known by that name. The ice sheets of this epoch were the chief factors in shaping the surface of northeastern Illinois. The local evidence points to three substages, characterized chiefly by differences in areal distribution and in the constitution of their tills. The three stages are connected with three terminal moraines, namely, the Bloomington, the Marseilles, and the Valparaiso moraines. Part of the ground moraine also can be assigned to one or the other of these stages (Fig. 20), although it is not possible at present to limit definitely the areal extent of the deposits of any of these stages.

Bloomington stage.—Early in the Wisconsin glacial epoch a lobe of ice moved into Illinois, advancing beyond the great bend of the Illinois River southward as far as Bloomington. Along its outer margin it built up a massive morainic ridge, the Bloomington terminal moraine. There followed a period of recession, with some oscillation. At this time a sheet of till was spread over La Salle County, which forms in large part the ground moraine of the western part of the county, including the prairies southwest of Starved Rock.

The Bloomington till can be distinguished by its bright color, commonly pink or blue in the region under consideration, and by its compactness, gritty texture, and the abundance of water-worn gravel imbedded in the clayey parts of the till. The compactness seems to be the result of pressure. If stones are removed from the till, they leave a perfect mold in the clay. The water-worn pebbles are largely chert.

Much of the Bloomington till is overlain by stratified drift, largely silty, and probably deposited in ponded water.

Marseilles stage.—The Marseilles stage, distinctly later than the deposits of the Bloomington till, found its chief expression in the Marseilles moraine, also known as Mission Ridge and the Rutland Hills, which is easily the largest terminal moraine in the upper Illinois Valley. It has a width of about 10 miles and a height of 100 to 125 feet. It probably does not mark the maximum advance of the ice of the Marseilles stage, but it marks the site of the ice edge during a long period. Farm Ridge, south of Starved Rock, probably forms the extreme limit attained during this period (Fig. 20). It is an incomplete morainic loop attached to the Marseilles moraine, and its till resembles that of the Marseilles terminal moraine more than it does the till of the adjacent Bloomington ground moraine. The Marseilles till is distinguished from the Bloomington till by its less bright color, the smoother texture of its matrix, the greater number of striated and planed bowlders, and more numerous lenses of stratified drift.

Close of the Wisconsin epoch.—After the ice which formed Farm Ridge melted, the immediate vicinity of Starved Rock probably was not again covered by glacial ice. To the east, however, a later glacier reached the Illinois Valley at Minooka. It formed also the great Valparaiso moraine that hems in the basin of Lake Michigan and marks the last glacial invasion of Illinois.

ORIGIN OF THE UPLAND CLAY

A short distance from the river the land is in many places so nearly level that the eye fails to detect any unevenness. In most fields no bowlders are to be seen. Even close search in many places does not reveal a single stone on several acres. Yet in most places typical till, rich in bowlders, lies at the depth of a few feet. Most glacial soils are at least moderately stony, and few glacial surfaces are level. In both these respects the region differs from most glaciated areas.

The anomaly is due to the upland clay that mantles most of the prairie. Its origin cannot be sought in a single cause. It has been suggested that it is a residual clay, formed by the decay of till and of vegetation and added to by burrowing animals. These are the ordinary processes by which soil is formed from drift. The upland clay, however, has almost invariably a sharp contact with the underlying material, and in composition it is almost independent of the formation beneath it. At Utica one can see fertile fields, which at a depth of a few feet are under-

lain by sandstone. In places the upland clay rests directly upon gravel and furnishes a soil that cannot be distinguished from the average prairie land. Evidently, except in minor part, it is not a residual product. For the most part it is probably of glacial origin. During the recession of the ice great quantities of water were formed. Drainage channels like the Illinois took care of much of this water. A great deal of it, however, spread in sluggish sheets over the ground moraine of the prairie upland and there formed beds of mud. Later the wind shifted about great quantities of dust on the bare upland, especially from the heavily aggraded valleys. In these ways a clayey deposit was formed which masked the ground moraine, and which differs sharply in physical constitution from the true glacial drift, and has but ill-defined limits of distribution. How much of the clay was deposited by sluggish waters and how much by the wind is unknown

HISTORY OF THE ILLINOIS VALLEY

Enormous quantities of water were formed by the melting of the ice sheets. During the latter part of the Ice Age, at the least, these waters found locally a line of discharge down the Illinois Valley, which in part antedates the later Ice Age.

PREGLACIAL AGE OF PART OF THE ILLINOIS VALLEY

The course of the Illinois River resembles the letter L, making a nearly rectangular turn at Hennepin. Below this bend the river flows in a great preglacial valley which it has inherited and which was made by a master stream, probably greater than the present Illinois River. Above the bend the valley is much younger. It is narrower and much of its bottom has not been worn down to base level. Four possibilities are to be considered here: (*a*) The present river has occupied the valley of a preglacial tributary of the master stream referred to above; (*b*) it has united parts of preglacial valleys; (*c*) it formed its valley during the Ice Age; (*d*) the valley is of postglacial origin. The second of these hypotheses seems most probable, although the evidence is not conclusive. The alluvial character of the valley bottom below Utica and in the Morris basin, together with the courses of buried valleys, give at least a suggestion of such origin. On this hypothesis a preglacial divide possibly was located near Starved Rock.

EXISTENCE OF THE UPPER ILLINOIS VALLEY DURING THE ICE AGE

At various places in the upper Illinois Valley evidence may be found indicating its existence during the Ice Age. This proof is of varied

nature and for the most part is found along the Illinois above Starved Rock.[1] From the evidence the conclusion may be drawn that the upper valley existed almost in its present size before the close of the Ice Age. Its beginnings therefore were probably much earlier

There are indications that the canyons about Starved Rock are not wholly of postglacial origin. The similar canyon of Clark's Run at Utica presents clear evidence of greater age. For a mile back from the river bluffs its canyon is aggraded heavily with glacial sands and gravels. The road leading north from Utica crosses a small gravel flat at the cemetery. Farther up the run sand and gravel conceal, for the most part, the bluffs of sandstone. About a mile north of the river bluffs is a bed of stratified drift 30 feet thick, reaching from the top of the valley to within 25 feet of the creek bed. It consists of well-bedded deposits that lie hard against a sheer rock wall, which is transverse to the direction of the valley and probably marks an old fall—the head of Clark's Run at the time of the filling of the valley. Up to this point the valley antedates the last ice. From this point to the head of the canyon the valley is narrow and the sides are free from sand or gravel, except for a little slumped material. The unfilled part of the canyon is about a quarter of a mile long and has been cut since the date of glacial filling. A comparison of the time required to cut the lower mile of the canyon, which must antedate the Marseilles stage of the ice, with that for the quarter-mile at the upper end throws light not only on the age of the valley of Clark's Run but also on that of its main.

NATURE OF GLACIAL DRAINAGE

The numerous beds of stratified drift along the valley attest the importance of the Illinois Valley as a line of glacial drainage Some of the stratified drift is buried beneath till and bears evidence of much greater age than the till above. These older beds form an obscure record of the discharge of sediment-laden waters from an unidentified earlier ice sheet.

Deposition of the high-level gravels.—On Parkman Plain, within the limits of Starved Rock Park, is a bed of gravel and sand more than a hundred feet above river level. On both sides of the valley similar detached beds are found from Ottawa to Hennepin. The material is uniformly coarse and virtually as angular as the stones and sand in till. Associated with these beds is a remarkably harmonious filling with similar

[1] Ill. Geol. Surv. *Bull.* 27, pp. 89–99.

materials of the lower courses of a number of tributary valleys, as of Clark's Run and the Vermilion rivers.

The fact that these gravels, extending along the main valley from Ottawa nearly to Hennepin, as well as along the lower tributaries, are nearly uniform in coarseness necessitates the conclusion that they cannot have been carried out from a single, nearly stationary ice front, such as the one at Marseilles. In that case the deposits would grow finer and finer downstream. Apparently they were deposited at the front of the ice sheet as it retired up the Illinois Valley. At Starved Rock the filling may have been in part from the Marseilles position of the ice (Fig. 20), from which great quantities of water were discharged, probably completing the task of aggrading the valley. Subsequent extremely vigorous erosion removed the greater part of the gravel beds, but remnants abundant enough to show their original nature still exist.

After the ice of the Marseilles stage had melted, its moraine served for a time as a dam behind which a large temporary lake formed. This lake covered the Morris basin and formed there thick beds of fine lake clays.

The last deposits by glacial waters.—Before the next ice sheet invaded the upper Illinois basin the dam at Marseilles had been cut through, so that the waters issuing from the last ice sheet discharged freely down the Illinois Valley Extensive gravel beds accumulated in the Fox and Des Plaines valleys, and the Morris basin was aggraded heavily with sand and fine gravel. At Starved Rock outwash of this period has not been discovered. Sedimentation at this distance from the ice was undoubtedly much reduced. The material, if any was deposited here, could have been only fine sand and silt, which readily lost its identity in alluvial deposits of later date.

Outlet River.—After making the Valparaiso morainic belt the last ice sheet retreated northward and northeastward. Between its edge and the moraines a lake, the direct ancestor of Lake Michigan, was formed. Back of this morainic dam the water rose until it overflowed a depression above Lemont, thence it discharged down a trough between moraines, now the Des Plaines Valley, and thus into the Illinois Valley. This glacial spillway was the Outlet River (Fig. 20).

The Outlet River had a large volume and a high velocity. During the preceding stage the Illinois Valley and Des Plaines trough had been filled with sediments to a large extent. To excavate a channel in this valley train was the first task of the young but vigorous stream. In the narrower parts of the valley it did this work well, leaving only

scattered traces of the outwash deposits. Beyond this its work seems to have resulted in deepening the valley, probably 40 feet or less, and in widening its bottom. The scant talus and the general absence of drift along the bluffs indicate that they may have been trimmed by the stream. Greater results probably are not to be ascribed to the Outlet River. Its career was spectacular but brief. Large streams of great volume and duration discharged through this valley repeatedly during the Ice Age. These streams, ice sheets, and probably preglacial and interglacial streams excavated the greater part of the upper Illinois Valley. The Outlet River has merely impressed upon it its present form.

With the continued recession of the ice the Great Lakes took shape. After a time outlets to the east were uncovered at lower elevations than the one at Chicago, which was abandoned. The modern Illinois River was then formed by drainage from the present Kankakee and Des Plaines rivers. Recently man has re-established drainage along the old glacial outlet by cutting the Chicago Drainage Canal. East of Lake Michigan there is in progress a warping of the land, which it is estimated would have diverted again, in the course of several thousand years, some of the waters of Lake Michigan to the western outlet through the Illinois Valley.

POSTGLACIAL CHANGES AND PRESENT CONDITIONS

Since the close of the Ice Age the region has not been the theater of conspicuous physiographic events. Its surface, however, has continued to be modified by physical processes of manifold kinds.

SHIFTING OF DUST AND SAND

In dry summer weather high winds pick up much dust from roadside and field and scatter it far and wide. The amount thus shifted is large and tends to produce uniformity of soils. On the floor of the valley, between Ottawa and Armstrong Brook, at the eastern end of the park, there are numerous low ridges, designated "islands" by the farmers. They are composed of sandstone, veneered with wind-blown sand. The land around them is gravelly. The coating of these "islands" has been derived in large part from sand which is mixed with the gravel. On the western end of Buffalo Rock are a number of small ridges of sand 10 to 15 feet high. Their present form, at least, is the result of wind work.

LEACHING AND DEPOSITION BY GROUND WATER

Underground water flows off as surface water does, only much more slowly. Because of its intimate contact with rock surfaces and because it is under pressure the ground water is an effective solvent and becomes charged with more or less mineral matter. All the local

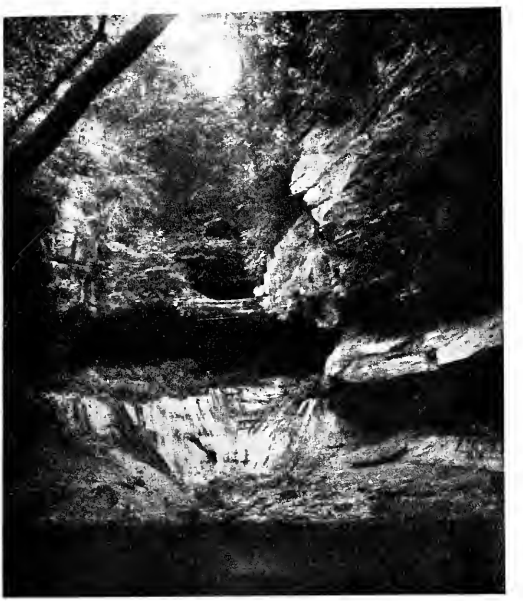


FIG. 21.—Tributary canyon in Deer Park Glen. This small canyon, like the larger ones about it, is cut in St. Peter sandstone. In its caldron the light streaks indicate the deposition of soluble salts, chiefly magnesium and calcium carbonate, leached from the cement of the sandstone.

wells that penetrate into rock yield mineralized water. The St. Peter sandstone, Prairie du Chien limestone, and some of the "Coal Measures," for instance, contain a great deal of iron sulphide, from which the water derives sulphureted hydrogen. Its taste, at first disagreeable, soon

becomes highly palatable to most people. The well at the hotel at Starved Rock is of this sort, but less mineralized than most of the wells in the valley. Wells or springs in the "Coal Measures" are usually distinguished by a bitter taste, due to a variety of salts leached from this formation. Of this type is the salt spring in South Ottawa.

The discolorations, shown in Fig. 21, are caused by the evaporation of ground water as it seeps to the surface and deposits the mineral matter it contains. Stains of this sort are common in the canyons. They are usually white or brownish and are principally due to compounds of calcium, magnesium, and iron, together with some silica.

On Starved Rock there are concretionary nodules of iron oxide and sand imbedded in the sandstone. "Iron stones," hollow masses of iron oxide with concentric layers, are common concretions in the glacial gravels along the Big Vermilion. Both of these types of concretions are features of deposition by ground water. In both drift and sandstone iron is present in small quantities only, yet forms the most conspicuous concretions. The ground water has removed it largely from the body of these formations and concentrated it into concretionary forms.

An extraordinary feature of the fluvio-glacial deposits are the "cement beds." In excavating a gravel pit the workmen encounter, in places, a layer of firmly cemented gravel which retards or blocks further operations. These cement beds are postglacial conglomerates, formed by deposition of lime carbonate from the ground water in the gravel beds. The cementation of a certain bed as distinct from others is due to differences in texture, which affect ground-water circulation. These cemented beds are well shown in gravel pits along the Big Vermilion.

SPRINGS AND FLOWING WELLS

The water supply is unusually good. Springs are numerous in the vicinity of Starved Rock, and where they are lacking good water is secured readily by drilling. The two sources of water in the park are the well at the hotel and the spring at the base of Pulpit Rock.

There are various water-bearing formations in the district, all of them being porous beds. In the drift are many lenses of gravel imbedded in the compact till or lying on bed rock. Where these gravels are permanently below the surface of the ground water they are perennial reservoirs. Outcrops of gravel on the sides of the Vermilion Valley give rise to weak springs. The older, dug wells on the prairie are sunk into beds of stratified drift. They furnish a good and accessible water supply, which has become insufficient, however, as the feeding of

stock has increased. Wells of this type generally range from 20 to 50 feet deep.

Among the bedded rocks the St. Peter sandstone yields most water. Its numerous springs issue for the most part from fissures in which the water collects. The formation is accessible by drilling almost everywhere along the upper valley and is the source of most of the well water used in the valley above Starved Rock. At Utica some wells derive water from porous beds in the Prairie du Chien formation, and at Ottawa the still lower Potsdam sandstone has been tapped at a depth of more than a thousand feet.

Almost every drilled well in the Illinois Valley or in its larger tributaries is flowing, including the ones at Starved Rock and Utica. The flowing wells are located most largely in the St. Peter sandstone and Prairie du Chien limestone and are not very deep. A part of the water in these formations enters where they outcrop in the region about Starved Rock; but much of it gets into the formations, especially the St. Peter, where they come to the surface in southern Wisconsin at elevations much higher than the Illinois Valley. Between southern Wisconsin and the Illinois Valley the sandstone is buried deeply beneath relatively impervious formations. A large part of the rain that falls on the St. Peter sandstone in Wisconsin sinks beneath the surface and flows south through the southward dipping beds of porous rock, as in a vast set of sand-clogged water mains. The water thus comes under constantly increasing pressure and where tapped by wells flows forth with considerable force. The higher parts of the prairie are without flowing wells, as the pressure is insufficient to carry the water to the surface.

WEATHERING AND SLUMPING

The gradual and unobtrusive breaking up of surface materials is going on actively and continuously. The forces at work include the atmosphere, ground water, changes of temperature, growth and decay of vegetation, and other processes. Largely by weathering soil is formed. By the disintegration of surface materials the land is prepared for erosion.

Loose material, especially if weathered, may creep down slope. Freezing and thawing especially aid the motion of the mass, and a soaking rain may lubricate it to such an extent that it may slump suddenly for some distance. Trees, poorly poised on steep slopes and insecurely rooted, in falling may start material on its way down slope. The floors of all the canyons and the bases of most of the bluffs are partly concealed

by sandy débris that has fallen, crept, or slumped down (Figs. 13, 17). Here and there one can see a clump of trees whose trunks are tilted downslope as the result of a soil slip.

GROWTH OF VALLEYS

At the close of the Ice Age the Illinois Valley probably was the only pronounced drainage line of the region. Because of lack of drainage some of the surface water was held in morainic depressions and there formed ponds and marshes, some of which, in remote sections of the prairie, have persisted to this day. Chains of glacial depressions, especially between morainic ridges, collected run-off from surrounding slopes and directed it to the Illinois. Where this run-off from the prairies discharged over the river bluffs erosion commenced to develop valleys which were cut back gradually into the prairie. To this day the lower parts of the tributaries of the Illinois have deep and narrow valleys while in their upper parts they occupy broad, shallow, glacial depressions called "draws." The latter are almost untouched by stream erosion and form pastures, meadows, or even plowed ground.

The relief of the river slopes has subjected them to most vigorous erosion. Here gullies, or valleys in infancy, may be seen at many places. They are numerous along the Vermilion River and above the park on the headwaters of Armstrong Brook. Within the park they are not well developed, principally because the slopes are adequately protected by vegetation.

The canyons are somewhat more advanced in stage. They are young valleys, whose rivulets are actively wearing back the falls which interrupt their even flow. The water tumbling over the falls is not sufficiently large in volume and persistent in flow to be a highly effective agent of erosion. The basins at the foot of the falls (Figs. 10 and 19) are shallow, with gently sloping sides, and indicate that churn-drilling is not sapping the rock walls, as in most vigorously receding falls. Stones from the drift are available for drilling into the soft sandstone, but the waterfall is not adequate to set up effective churning. Horseshoe and Illinois canyons have grown enough to have nearly permanent streams, whereas the smaller canyons are eroded only intermittently. The two branches of Horseshoe Canyon have developed beyond the smaller canyons on either side, so as to limit the drainage area of their competitors to a narrow strip of land. Of the canyons in the park Illinois Canyon is in the most advanced stage of development. Its falls have been worn back farthest, it has the widest floor, the longest stream of nearly

perennial flow, and the largest drainage area, receiving most of its water from the east flank of Farm Ridge. Its growth has been handicapped somewhat by the nearness of Kaskaskia Canyon, but as one of the branches of Illinois Canyon has succeeded in flanking the headwaters of Kaskaskia Canyon the former has now a clear field for growth into the prairie. The lower portions of the canyon floors are as a rule worn as low as the present level of the Illinois will permit. Here tiny flood-plains of nearly pure sand are forming (Fig. 14).

The Big Vermilion River is in a state of adolescence. Its slopes are still steep and its flow is disturbed by "riffles," but the river is beginning to construct an alluvial flat along its lower course.

At Starved Rock the Illinois River is just passing out of youth. It has not quite finished the task of wearing down its bed, and its present alluvial tract is not wide. Below, the stream is sluggish and no longer able ordinarily to erode its bed. This part of the valley is mature and contains sloughs cut off from the river (Fig. 6). Two of these, Starved Rock Lake and Lost Lake, are within the park. Both lie in the flood-plain and occupy remnants of abandoned river channels. The map indicates that they have diminished in size; a swampy tract extends east of Lost Lake, and the depression contour which incloses Starved Rock Lake surrounds an area considerably greater than that of the lake. Both lakes are bordered by abundant swamp vegetation whose decayed remains help to fill them. They are also subject to filling by overflows, dust-bearing wind, and other agencies, and will be short-lived unless perpetuated by man.

The sluggish current of the mature portion of the Illinois River is obstructed in many places by bars of mud and sand. The largest are at the mouths of the Vermilion rivers. Both of these streams have a much more vigorous flow than the Illinois. Where their waters are discharged into the latter they are in a measure ponded by its more sluggish current. As a result much of the sediment which they had been carrying is dropped and forms bars

From time to time the Illinois has shifted its course, leaving abandoned channels to mark its previous sites. Some of these have been utilized by the Illinois and Michigan Canal (note in the topographic map the swampy area between the Hager School and the "wide-water" of the canal). Others have been appropriated by tributaries left without other means of outlet. The course of Armstrong Brook is an example. As the water from the easternmost ravine reaches the bottom of the Illinois it turns west and parallels the river. The same is true of each

succeeding ravine, and only after the stream from Ottawa Canyon is added does Armstrong Brook join the Illinois. This creek occupies in fact a deserted channel of the river and collects the drainage from a number of ravines which at one time discharged directly into the river and were independent of each other. Hennepin Canyon, similarly, ends in a slough that hugs the base of the bluff for more than half a mile before it enters the Illinois. This obscure depression was at one time occupied by the Illinois, then flowing hard against the bluffs.

MAN AN AGENT OF EROSION

Normally, changes of surface are slow and gradual. Recently, however, man has stimulated tremendously the erosive forces. Early travelers have alluded pleasantly to the Illinois River that flowed limpid and pure. They wrote of bands of dark green forest that outlined afar the courses of prairie streams and of great expanses of waving prairie grass that stretched as far as the eye could see. In those days the Indian ruled the land. He subsisted by the chase and did little or nothing to alter the natural conditions of the surface. When the settler came all this was changed The prairie sod was broken and its soil was laid bare to wind and weather. The trees on the slopes were cut because of the scarcity of timber, and the protecting cover of vegetation on the sides of the valleys was destroyed. Depressions in the ground moraine were drained. After a time most of the land was put under cultivation. Corn became the principal crop, and the clean tillage which it requires restricted the accumulation of humus in the soil. All of these things increased the ease with which the water flows off, and hence stimulated erosion. The enlarged run-off carried more sediment into the streams, and consequently rivers which once ran clear became murky with a load of mud. In some parts of the Illinois basin, as along the Fox Valley, the gullying of the surface has become a serious matter. Fortunately, at Starved Rock the steeper slopes have remained well wooded, and their erosion is therefore negligible. It is to be noted, however, that the protection of the park extends only to the lower courses of the tributaries, and that abuse of the privately owned upper courses in the future may possibly become a matter of concern.

The industrial operations in glass sand have been a serious menace to the physiographic integrity of the region. The limited outcrops of the St. Peter sandstone are largely in the hands of sand companies. At present the pits are confined mostly to the northern side of the valley because of better transportation facilities. It was recognized, however,

some time since that the destruction of Starved Rock and its canyons was inevitable unless steps were taken for their permanent preservation. Public sentiment was aroused, and the safety of most of the important scenic features has been assured by the creation of the state park. No matter to what extent the northern slopes may be desolated by sand pits the people of the state are now secure in their enjoyment of Starved Rock, the canyons, and the surrounding forest.

EXPLORATION, SETTLEMENT, AND DEVELOPMENT OF THE REGION

THE FRENCH COLONIAL EMPIRE

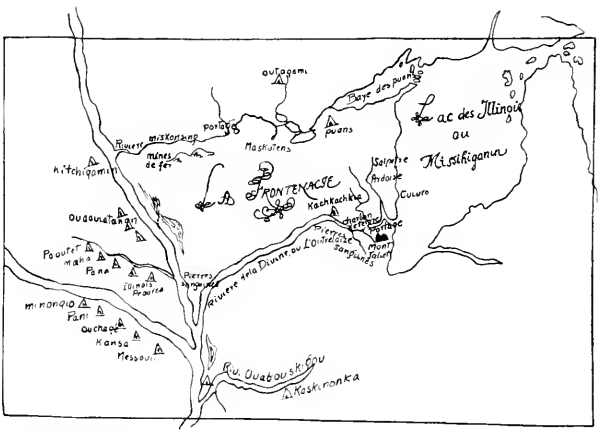
Starved Rock looks back upon a long and distinguished history. Upon this eminence was staged one of the first acts in the discovery of the West. No trace of this early history, however, has been preserved by ruin or relic of any sort; for a record of it we must turn to the centuries-old relations of the Jesuit fathers and to letters and journals of soldier-adventurers.

DISCOVERIES IN THE WEST

France was one of the first nations to participate in the exploration of the New World, and by a series of intrepid expeditions secured prior footing on the northeastern coast of the continent. Colonization was begun early in the seventeenth century. The founding of Quebec in 1608 followed the Acadian settlements of 1604–5. In 1611 the beginnings of Montreal were made. In 1634 Jean Nicolet discovered Lake Michigan, and in 1673 Marquette and Joliet reached the Mississippi River. On their outward journey Marquette and Joliet used the Fox-Wisconsin river route, but on their return they chose the Illinois River instead because of its gentle current and direct course. These two men are the first white men known to have passed Starved Rock, although it is possible that Frenchmen had visited it at an earlier date. Joliet, on his return, published several maps of the western region. Fig. 22 is reproduced from one of them, noteworthy for the knowledge which it shows of the Great Lakes and part of the Mississippi Valley. It is the first map known to have been published of the Mississippi River system. Both Great Lakes and Mississippi River system are shown in considerable detail. Lake Michigan is Lac des Illinois; the Illinois River, La Divine. The explorations which furnished the greater part of these data were not made by Joliet or Marquette, but were collected from

Indians, and also in all likelihood from *coureurs de bois,* woodsmen who seem to have been familiar with much of this country before any recorded explorations were made.

Within sixty-five years after the first feeble settlements had been planted at Quebec, Frenchmen had discovered the Mississippi and were acquainted with the Illinois Valley, more than a thousand miles away. This phenomenal expansion of a handful of men over half a continent



After "Jesuit Relations," LIX

FIG. 22.—Sketch of a part of Joliet's map of 1674. The Illinois River is called Riviere de la Divine and Lake Michigan Lac des Illinois. The nature of the Mississippi drainage system is shown with a fair degree of accuracy. Headquarters of Indian tribes are shown by tepees. Names have been relettered for the sake of legibility and a number of features of the map are omitted.

stands almost without a parallel in history. At this time the English of the New World were still confined to a narrow strip along the Atlantic seaboard, nor did they cross the mountains to the Mississippi basin until many years later.

The causes which dispersed the French over the northern part of the continent were of the most varied sort. (*a*) The lure of the unknown was strong upon the people of Western Europe at the time. To the West lay new wonders awaiting discovery. Restless spirits with strong

aversions to the routine tasks of civilized communities were attracted by the mysteries of the New World. The chance for a good fight now and then and the uncertainty of life itself drew adventurers to these parts. Exploration was not pure romance, however. Decidedly practical reasons served as incentives. (*b*) For generations the quest for a western passage to the Indies was pursued diligently. Explorers pushed hundreds of miles into the wilderness, expecting at almost every turn to discover the long-looked-for passage that led to the western ocean. Not until long after the time of La Salle was this hope abandoned. (*c*) The French expected to find great mineral wealth in the north of America, as the Spaniards had done in the south. This was one of the earliest motives of colonization[1] and is expressed again and again in imaginative reports sent to France by explorers. Indications of minerals were magnified absurdly. Gross errors in identification were common, as shown by the fact that gold was reported from many a locality where gold has never been found. These stories were not investigated but acclaimed as facts. (*d*) The greatest of all incentives was the fur trade. In it the French had an easily available resource that made up largely for the deficiencies of soil and minerals and for the harsh climate of their northern territory. The fur trade, above all other incentives, attracted the French to the far interior. Two or three men could handle the output of a small Indian tribe. The newcomers in this business therefore had to look farther and farther inland for trade. As furs furnished the principal revenue of the government the officials were interested in fostering it. The French administrations took care not to drive out the Indians but to aid them. (*e*) When Father Marquette set out to find the Mississippi and thus incidentally brought back word of the Illinois River he was actuated by no motive of material gain. He saw in this great region a vast field for missionary endeavor. Here were thousands lost in the night of heathendom. Could he but save a single soul, he said, his journey would not be in vain. With highest fortitude and singular steadfastness members of the various religious orders, Jesuits, Recollects, Sulpitians, and others, braved hardships and suffered even death in the service of their ideal.

The nature of the waterways was of the greatest assistance to French colonization. On the seaboard their chief settlements were at the mouth of the St. Lawrence, and the most used route to the Great Lakes was by this and the Ottawa rivers. From the lakes it was not difficult to reach the Mississippi Valley. Short, navigable rivers led back from the lakes

[1] Winsor, *Narrative and Critical History of America*, IV, 55 and 57.

at various places, and up these they could paddle their boats to a portage that led across to some tributary of the Mississippi. The Chicago-Illinois river route was such a natural thoroughfare and was much used during the whole French period At the usual stage of water there was only one portage on this route, an easy matter for the light canoes then in use. Occasionally, in spring, they were able to go from Lake Michigan to the Des Plaines without portaging, as the swampy watershed was subject to flooding. It is doubtful whether the French could have penetrated to the heart of the continent without the aid that drainage conditions gave them. It is certain that the lack of similar aids was responsible largely for the belated entry of the English into the Mississippi Valley.

THE MISSION AT KASKASKIA

On ascending the river Marquette noted on the north bank of the river, below Starved Rock and near Utica, "a village of Ilinois [Indians] called Kaskaskia" (Fig. 22). His party landed, and he observes, "They received us very well, and obliged me to promise them that I would return to instruct them."[1] The following year, 1674, the intrepid father, although suffering from a lingering illness, decided to make good his word and to found a mission at Kaskaskia, where no missionary had ever labored. After a hard winter spent on Lake Michigan, the *Jesuit Relations* says, "his health improving, he prepared himself to go to the village of the Ilinois as soon as navigation should open—which he did with much Joy, setting out for that place on the 29th of march (1675). . . . . On at last arriving at the village, he was received as an angel from Heaven."[2] The tribe was quickly assembled to attend the message which he had come to deliver: "It was a beautiful prairie, close to a village, which was Selected for the great Council; this was adorned, after the fashion of the country, by Covering it with mats and bearskins. . . . . The father addressed the whole body of people, and conveyed to them 10 messages, by means of ten presents which he gave them . . . . then he said holy mass. On the third Day after, ... he celebrated the holy mysteries for the 2nd time; And by these two, the only sacrifices ever offered there to God, he took possession of that land in the name of Jesus Christ, and gave to that mission the name of the Immaculate Conception of the blessed virgin."[3] This act closed Marquette's missionary career. His health again failed and he was forced to leave the sorrowing tribe. His death took place on the way to the French settlements.

[1] *Jesuit Relations*, edited by R. G. Thwaites, LIX, 161.

[2] *Ibid.*, pp. 187–89. [3] *Ibid.*, pp. 189–91.

In 1677 Father Allouez came to restore the mission of the Immaculate Conception. On April 27 he says: "I immediately entered the cabin where Father Marquette had lodged, and the sachems with all the people being assembled, I told them the object of my coming among them, namely, to preach to them the true, living, and immortal God, and his only Son, Jesus Christ."[1]

"I laid the foundation of this mission by the baptism of thirty-five children, and a sick adult, who soon after died, with one of the infants, to go and take possession of heaven in the name of the whole nation. And we too, to take possession of these tribes in the name of Jesus Christ, on the 3d of May, the feast of the Holy Cross, erected in the midst of the town a cross twenty-five feet high, chanting the Vexilla Regis in the presence of a great number of Illinois of all tribes." . . .[2]

These are the first chronicles of white men in the upper Illinois Valley. In both cases the pioneers were Jesuit missionaries. The first structure erected by the hands of a white man was a giant cross that cast its protecting shadow over the bark huts of the Indians, a symbol of peace and civilization. In later years other priests came and went, among them Gravier and Marest, but after the departure of Father Allouez missionaries no longer had the field to themselves.

LA SALLE AND HIS PROJECTS

The partnership of Marquette, the missionary, and Joliet, the fur trader, is typical of New France. In some places the pioneer was a black-gowned clerical, at others a profit-seeking trader or trapper. Where the one came the other was almost sure to follow. A third type of pioneer was the soldier-adventurer, imposing to the Indian by the pomp of arms and the splendor of the king's coat. To this class belonged La Salle.

In the exploration of the Mississippi Valley the honors are divided between Joliet and Marquette on the one hand and La Salle on the other. The former were interested in the Illinois Valley in a minor way only, whereas La Salle made its river a French highway and made its name familiar throughout the French world.

Robert Cavelier, Sieur de la Salle, was a born adventurer to whom the unknown West early proved an irresistible attraction. His self-set mission in life was to push back the borders of the unknown. His journeys of explóration extended from Niagara Falls to the Gulf Coast

[1] Shea, *Discovery and Exploration of the Mississippi Valley*, p. 74.

[2] *Ibid.*, p. 77.

and have earned for him a prominent place in the annals of French America. At first his aim was the discovery of a passage to the Indies, but soon this became merged into the larger plan of a colonial empire in the heart of the continent. Among the bases which he established for his purpose the fort at Starved Rock held high place in his ambitious designs.

It is possible that La Salle was the first white man to set foot in the Illinois Valley, in the year 1670.[1] In this year he made a long reconnaissance, which possibly brought him to the Illinois. At least by the year 1677 he had seen enough of the Mississippi Basin to become fired with its possibilities and had committed himself definitely to a project of colonization in that region. His plans are expressed in a remarkable memorial to the minister Colbert at Paris, in which he says of the region:

It is nearly all so beautiful and so fertile; so free from forests, and so full of meadows, brooks, and rivers; so abounding in fish, game, and venison, that one can find there in plenty, and with little trouble, all that is needful for the support of flourishing colonies. The soil will produce everything that is raised in France. Flocks and herds can be left out at pasture all winter; and there are even native wild cattle, which, instead of hair, have a fine wool that may answer for making cloth and hats. Their hides are better than those of France. . . . . Hemp and cotton grow here naturally, and may be manufactured with good results; so there can be no doubt that colonies planted here would become very prosperous. They would be increased by a great number of western Indians, who are in the main of a tractable and sociable disposition; and as they have the use neither of our weapons nor of our goods, and are not in intercourse with other Europeans, they readily adapt themselves to us, and imitate our ways of life, as soon as they taste the advantages of our friendship and of the commodities we bring them; insomuch that these countries will infallibly furnish, within a few years, a great many new subjects to the church and the King. It was the knowledge of these things, joined to the poverty of Canada, its dense forests, its barren soil, its harsh climate, and the snow that covers the ground for half the year, that led the Sieur de la Salle to undertake the planting of colonies in these beautiful countries of the West.[2]

In these words La Salle expressed the plan that had taken shape in his wanderings, a splendid vision of French husbandmen tilling the fertile fields of the West, of French towns developing trade and industries, and of tribes of enlightened Indians dwelling among them peaceably. In contrast to the general blindness of the French officials to every opportunity except that of the fur trade this comprehensive colonial

[1] Parkman, *La Salle and the Discovery of the Great West*, pp. 23–27.

[2] Parkman, *op. cit.*, pp. 110–11.

program stands forth most favorably. It is perhaps the first published appreciation of the resources of the West and is memorable for its geographic adequacy. In the annals of French America no colonial project of greater merit was advanced and none which recognized so clearly the necessity and opportunity for enduring agricultural colonies.

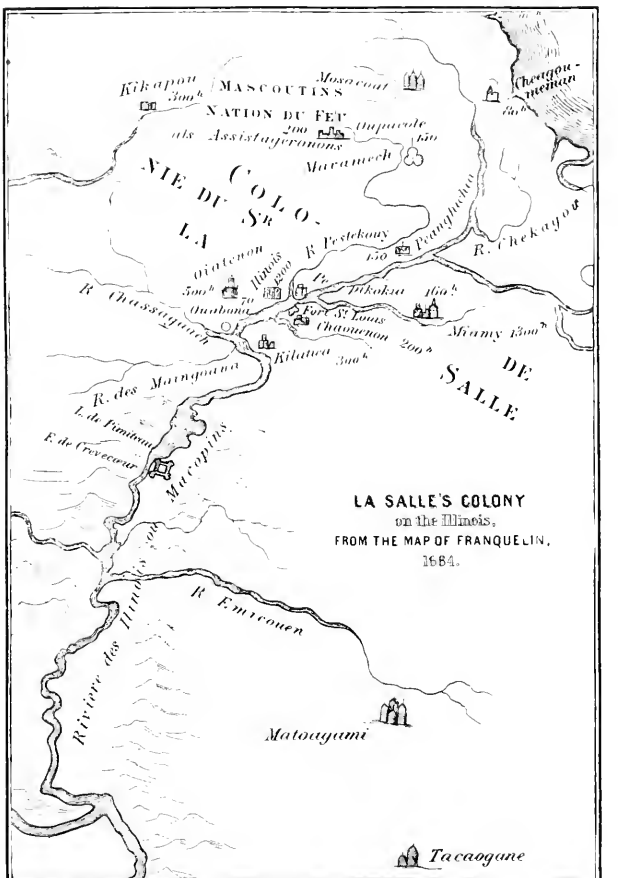
La Salle and the period of reconnaissance.—At the close of the year 1679 La Salle and his party, among them Henri de Tonty, the man of the iron hand, and Hennepin, friar and chronicler, entered the St. Joseph River from Lake Michigan and ascended it to a portage across to the Kankakee. This devious stream they followed to the Illinois. Their store of food became exhausted, and to replenish it they landed below Starved Rock at the Indian village. The first winter in Illinois (1680) La Salle's party spent below Lake Peoria. Here they built a rude fortified camp, Fort Crevecœur (Fig. 23), and began the construction of a boat in which La Salle hoped to explore the Mississippi to the sea.

In the years that followed La Salle was engaged in exploring expeditions, during the greatest of which he descended the Mississippi to its mouth and followed the Gulf Coast for a distance. Between these journeys he made occasional trips to the French posts of the East for the purpose of improving his ever-tottering credit and of silencing his numerous critics. It was during this time that La Salle conceived the plan of cutting loose from Canada and of establishing direct relations with the mother-country. Henceforth the Mississippi and the sea were to become the outlet for the inland empire which he had in view.[1]

The plan of a base on the Illinois.—Through his various trips La Salle became impressed with the strategic value of Starved Rock and the advantages of its location in the heart of a rich country. While returning east in the spring of 1680 he made note of this fact and dispatched orders to Tonty, at Crevecœur, to erect a fort on Starved Rock. According to *Tonty's Account*, "at the village of the Illinois he resolved to build another fort on rising ground, in order to command the Miamis, Outagamis, Kikapous, Aisnous, and Mascoutans; and to serve likewise for a place of refuge to the French."[2]

[1] Parkman, *op. cit.*, pp. 201–92.

[2] In *Collections of the New York Historical Society*, II (1814), 247–48. Probably Tonty is not the author of this publication (Winsor, *Narrative and Critical History*, IV, 240). Published in 1697 and containing a rather full statement of conditions in the Illinois country, it is nevertheless a valuable source. In so far as the local area is concerned there is no reason for questioning the veracity of the account.



From Parkman, La Salle and the Discovery of the Great West

FIG. 23.—Franquelin's map of 1684, showing location of Indian villages and French forts. The R. Pestekouy is the Fox.

While Tonty, obedient to his orders, had quartered his party at the Illinois village in preparation for the erection of the fort, a great disaster occurred which canceled all immediate plans. One day the Indian village was shaken from its somnolence by the alarm: "The Iroquois!" The rout that followed is described in La Salle's graphic account:

> The village of the Islinois was on the river bank on the northern side. On the south there is a great bluff, quite high and exceedingly steep. This bluff lies back of a strip of land which declines gradually to the edge of the water, where it is covered with white oaks, the strip having a length of one or two leagues. A hundred steps beyond is a vast country which stretches far to the south and is drained by the river Aramoni, which empties into that of the Islinois (from which it is distant in that place three leagues) a little more than two leagues below their village, and is bordered all along by a belt of small timber.

The bluff spoken of lies south of Utica; the Aramoni is the Big Vermilion; the country described is the prairie of Deer Park.

The alarm having been given, the Illinois set out to meet their enemies along the timber of the Vermilion. "Into this country the Islinois went with Msr. de Tonty at their head, followed by the Sieur de Boisrondet, and by another Frenchman. . . . . They beheld the Iroquois who were in force beyond the timber of the river Aramoni, and immediately ran to attack them. Msr. de Tonty, seeing the unequal chances, restrained them and attempted to negotiate with the enemy." In the parley which followed Tonty was struck down by an Iroquois but managed to return to the lines of the Illinois. The ardor of the Illinois soon cooled and they withdrew to their village. "The Iroquois following shortly after under pretext of seeking provisions, the Islinois well divined their true motive. They retired to the place where their old men and women were concealed,[1] after having set fire to three of their lodges. The Iroquois burned the village and from the ruins of the lodges made a flimsy redoubt, where they entrenched themselves."[2] Then followed a horrid desecration of the Illinois burial-ground and the devastation of their fields. The Illinois, now thoroughly panic-stricken, fled down the valley on the right bank. On the left the Iroquois followed in hot pursuit. When it became evident to Tonty and his men that the Illinois were thoroughly demoralized they made good their escape to Green Bay. With the entire country in terror of the Iroquois it was necessary to await more quiet times for the construction of the fort.

[1] An island downstream. [2] Margry, *Découvertes et Établissements*, II, 122–23.

Fort St. Louis des Illinois.—Sometime after, probably in the early winter of 1682, La Salle found conditions opportune to proceed with the erection of the fort. He came "to the great village, whither many families of the Illinois were returned; he labored hard upon the inclosure of the new fort,"[1] and in the following spring it was completed.[2] The most exact description of Fort St. Louis, as it was named, and the best appreciation of its strategic value has been left by La Salle. Below it was

> the ancient village of the Kaskaskias Islinois who had abandoned it since the rout caused three years ago by the Iroquois. The news of the fort which I have built there has called them back, together with other nations. It is situated . . . . on the left in descending the river, on the height of a rock, precipitous on almost all sides, whose base the river laves in such a manner that one can draw up water from it to the summit of the rock, which is about six hundred feet in circumference. It is accessible only on one side, on which the ascent is still quite difficult. This side is barred by a palisade of stakes of white oak, from eight to ten inches in diameter and 22 feet high, flanked by three redoubts of squared beams, placed the one upon the other equidistantly, so that all sustain each other. The rest of the enclosure of the rock is surrounded by a like palisade, but only fifteen feet high, because it is inaccessible. . . . . There is also a parapet of thick trees lying lengthwise, the one upon the other, to the height of two men, the whole covered with earth, and at the top of the palisade a kind of chevaux-de-frise the points of which are iron-tipped to prevent scaling. The neighboring rocks are all lower than this one, and the nearest is two hundred feet distant, the others more, between which and the fort of Saint Louis extends on two sides a large dale which a brook traverses and inundates when it rains.[3]

La Salle had weighed well the strategic merits of the site. Starved Rock is a natural bulwark which could hardly be improved upon for primitive warfare. It was well said that twenty armed men could hold it against all the savages of Canada.[4] Because of its compact form only a small garrison was needed. Its position at the water's edge placed it in absolute control of the river and at the same time preserved the possibility of connection with the outside world in case of siege. The river also furnished the necessary supply of water. Fig. 23 is a reproduction of a contemporaneous map. Most of the time Tonty was in command of the fort. La Salle went on numerous expeditions and left his faithful

[1] *Tonty's Account*, *op. cit.*, p. 262.

[2] Tonty, *Memoir*, in *Historical Collections of Louisiana*, I, 66.

[3] Margry, *op. cit.*, pp. 175–76.

[4] Charlevoix, *Histoire et Journal*, VI, 120.

lieutenant in charge. After the completion of the fort, Tonty, it is asserted, wrote:

> I invited all the neighboring tribes to come to it. There needed no great pains or art to get them thither. The beauty of the country, the fruitfulness of the land, and the conveniency of a fine navigable river, the nearness of about a hundred different nations, and of those little lakes or rather little seas, which make a fit seat for the commerce of all North America, and reach from the river St. Laurent to the Gulf of Mexico. In short, the advantageous situation of this fort, which was designed as a bulwark for all the nations that should come to settle there against the irruptions of the barbarous nations was a sufficient inducement for them to come and dwell there. So that in a little time there was above five hundred huts made up, and in less than 9 months there was a wonderful great concourse of people of all nations. By this it is easy to be seen with how little difficulty the savages might be tamed and polished by planting here and there some colonies of Europeans.[1]

As he surveyed from his palisade the animated scene of many hundreds of Indians encamped amicably about his fort, Tonty was of no uncertain mind as to the advantages of the site.

The objects for which La Salle erected a fort on the Illinois were various. (*a*) Tonty referred to it as "a place of refuge for the French." The enemy most to be feared were roving bands of Iroquois. (*b*) To La Salle's expeditions it served as a base of supplies. (*c*) Perhaps its greatest service lay in the protection which it gave to Indian tribes. These Indians, settled under the stockade and at Kaskaskia, in their turn added to the security of the French from hostile invasions, and were used by Tonty for military expeditions. (*d*) Trade with the Indians supplied La Salle in part with the means to carry on his project. (*e*) Fort St. Louis was situated on the easiest line of communication between the Great Lakes and the Mississippi River. La Salle undoubtedly foresaw that the future commerce between the two regions would be largely under his control at this place. (*f*) Finally, it was a part of his great project of permanent colonization, in which the Indians were to be accustomed gradually to a sedentary life under the direction of French settlers.

Agriculture at Fort St. Louis.—La Salle's interests in agricultural colonization were destined never to be realized. He has, however, the distinction of having made the beginnings of agriculture in the Mississippi Valley. In one of his letters he wrote: "On the other side [of the Illinois] is a prairie which borders the river in which, at the base of the

[1] *Tonty's Account*, *op. cit.*, p. 286.

fort, there is a charming island, cultivated at other times by the Indians, where I and my habitants have sowed our crops within musket-shot of the fort, so that one can defend those laboring without the fort and can prevent the enemies from landing on the island."[1] The island is Plum Island, and so far as we know is the site where white men first undertook to farm within the limits of the Mississippi Basin. The fine alluvial soil grows splendid crops to this day and is most commonly planted in corn. This cornfield, framed in a fringe of trees, forms a charming detail in the view from Starved Rock (Fig. 2).

A few years later Joutel wrote: "That country is one of the most temperate in the world, and consequently whatsoever is sowed there whether herbs roots Indian and even European corn thrives very well as has been try'd by the Sieur Boisrondet, who sow'd of all sorts, and had a plentiful crop, and we eat of the bread which was very good."[2] Cultivation of the land, therefore, was continued here for a number of years with success. It is fitting that La Salle and Boisrondet be remembered as the pioneer agriculturists of the state, who first put to the test the fertility of its soil.

Resources of the region as viewed by the French.—Without exception the Frenchmen who wrote of this region were enamored of it and praised its attractions in lavish terms. All were agreed that here was an almost ideal place for colonization. The superstition of the bleak climate and barren soil of the prairies, so prevalent a century and a half later, had not arisen to disturb their good judgment Of the land and the life which it supported La Salle wrote in one of his earlier letters: "It [the Illinois] passes through woods which it inundates almost always, and which take away the view of the beautiful regions that are back of these drowned forests. . . . . These plains are covered ordinarily with wild cattle in prodigious number. . . . . The soil of it is excellent and seems to want only cultivation. There are here and there woods, brooks, hills, and valleys, all very agreeable."[3] Later La Salle gave a peculiarly happy account of the view from Starved Rock: "The rock masses which surround the fort . . . . are covered with oaks for a space of three or four arpents, beyond which there are vast stretches of exceedingly fertile lands [the prairie]. The other side of the river is bordered by a large plain which the Islinois cultivated formerly.[4] It joins a ridge of

[1] Margry, *op. cit.*, p. 176.

[2] Joutel, *Journal of the Last Voyage Performed by Monsr. de la Salle* (London, 1714), p. 172.

[3] Margry, *op. cit.*, p. 170.

[4] The account was written after the rout by the Iroquois.

great extent,[1] whose declivity is covered in places by woods and in others leaves large openings through which one discovers the [prairie] land which stretches beyond by certain knowledge, more than four hundred leagues."[2]

Tonty, who remained in the region longer than any of the others, reached this verdict: "It may be said to contain some of the finest lands ever seen."[3] The other account states: "The banks of that river are as charming to the eye, as useful for life. The meadows, fruit-trees, and forests, affording everything that is necessary for men and beasts."[4]

Joutel expresses himself with equal emphasis: "Nothing could be pleasanter, and it may be truly affirmed, that the Country of the Islinois enjoys all that can make it accomplished, not only as to Ornament, but also for its plentiful Production of all Things requisite for the Support of Human Life."[5]

Next to the fertility of the soil the French were impressed most by indications of mineral wealth. Of these things, it must be admitted, they were in general indifferent judges. Near Starved Rock, however, was made probably the earliest correct observation of the occurrence of coal in the United States. La Salle wrote: "There exists a quantity of slate and of coal [*charbon de terre*]; four leagues farther down, on the right, one finds the River Pestigouki [Fox], in which I have found a bit of copper, and a species of metal, ... which I believe to be bronze, if it is found in nature."[6] The coal observed was in the vicinity of Marseilles, where it crops out on the sides of the valley. The report of a find of copper may refer to pyrite, which is common on the Fox, or it may have been a piece of metallic copper in the glacial drift. The latter is the suggestion drawn from Tonty's statement: "A few pieces of pure copper, whose origin we have not sought, are found in the river of the Illinois country."[7] Joutel's information was somewhat more extensive: "On the sides of the hills is found a gravelly sort of stone, very fit to make lime for building. There are also many clay pits, fit for making earthenware, bricks, and tiles and along the river there are coal pits, the coal whereof has been try'd and found very good." It is easy to recognize in this account the limestone, clay beds, and coal seams of the "Coal Measures," all within a few miles of

[1] The northern side of the valley.

[2] Margry, *op. cit.*, p. 176. [3] *Historical Collections of Louisiana*, I, 64.

[4] *Tonty's Account*, *op. cit.*, p., 235.

[5] Joutel, *op. cit.*, p. 171; equally favorable accounts are to be found in the *Jesuit Relations* of Allouez, Gravier, Binneteau, Marest, Vivier, etc.

[6] Margry, *op. cit.*, p. 175. [7] *Memoir*, in *Ill. Hist. Colls.*, I, 145.

Starved Rock. The occurrence of coal was first made public in Joliet's map of 1674 (Fig. 22), which bears above Starved Rock the legend "charbon de terre." According to Joutel coal was used near Starved Rock several generations before it was put to use at Richmond, Virginia, usually considered the place where coal was first dug in this country.

Fate of St. Louis des Illinois.—For more than five years nothing occurred which disturbed seriously the prosperity of the post. Indian tribes from many parts of the prairie country flocked to it, and it promised fair to become one of the greatest centers of the Indian trade. At one time the fort was besieged for six weeks by five hundred Iroquois, but Tonty and his men held out staunchly until the Indians tired of their fruitless assaults.[1] A year later Tonty gathered a body of Illinois, Shawanoe, and Miami Indians, and retaliated with an invasion of the Iroquois country.

In 1687 La Salle was murdered while on the Gulf Coast. With him ended his projects, and the fate of Fort St. Louis was sealed. The last account of Fort St. Louis during its continuous occupation is from the pen of Joutel. It was written after La Salle's death, but before knowledge of it had been received by the garrison: "Fort Lewis is in the Country of the Islinois, and seated on a steep Rock about 200 Ft high, the River running at the Bottom of it. It is only fortified with Stakes and Palisades, and some Houses advancing to the Edge of the Rock. It has a very spacious Esplanade, or Place of Arms. The Place is naturally Strong, and might be made so by Art, with little Expence. Several of the Natives live in it, in their Huts."[2]

Among La Salle's followers there was none with vision clear enough or courage strong enough to go on with his work. Tonty and La Forest fell heirs to the command and continued at Fort St. Louis for some years. Tonty maintained some connection with the fort until 1702,[3] although it was not occupied continuously up to that date. St. Cosme reports having found it abandoned in 1690.[4] French traders were residing on "Le Rocher," as it was called, in 1718. Charlevoix, passing here in 1721, found only ruined palisades left, and ascribed them to the Illinois.[5] Thus the fort sank into oblivion.

Single-handed La Salle had tried to open up the Mississippi Basin to civilization. His life was a stubborn contest with the vast wilderness, with savage tribes, but most of all with intriguing foes in France and

[1] *Tonty's Account, op. cit.*, p. 286.

[2] Joutel, *op. cit.*, p. 171.

[3] Parkman, *op. cit.*, note on p. 441.

[4] *Ibid.*, note on p. 294.

[5] Charlevoix, *op. cit.*, p. 119.

Canada. Year after year he confronted hopeless odds with unfaltering determination. A staggering number of reverses failed to turn him away from his goal, and his failure was finally brought about through treachery. His magnificent plans were perhaps foredoomed to failure, because they were too vast for the powers of any one man. That they were sound, however, has been proven, for they have been realized to the full by another people, who found the country as pleasing and fruitful as La Salle knew it to be, and who planted in it the civilization of American stamp, which La Salle had planned to be French in its allegiance.

INDIAN TRIBES AND THEIR LIFE

The history of the Indians of this region is based in part on a few uncertain traditions handed down to the first American settlers by the Indians who remained at that time. The most trustworthy information is found in the records of the French, who knew them most intimately.

CHARACTERISTICS AND CUSTOMS OF THE ILLINOIS

When the French came to the region they found a group of Indian tribes of kindred blood, who called themselves Illinois.[1] The stream on which they lived the French called therefore "the River of the Illinois." Of the numerous tribes the Kaskaskias, inhabiting the great town below Starved Rock, the Kahokias, and the Peorias are best remembered Accounts of their character are conflicting; probably none of them were based on extensive knowledge. Marquette was very favorably impressed, but later observers did not confirm his opinion. Joutel, in particular, criticized the Indians severely as thieves, and "very great Lyars"[2] It is probably true that this semi-nomadic tribe with its few possessions had poorly developed ideas as to property rights. Of their tribal customs few records exist. The best one, dealing with local conditions, is a description of the burial ceremony at the burial ground below Utica. Here, we are told,

> they pay a Respect to their Dead, as appears by their special Care of burying them, and even of putting into Coffins placed high above the Ground, the Bodies of such as are considerable among them, as their Chiefs and others; . . . . when any of them die, they wrap them up in Skins, and then put them into Coffins, made of the Barks of Trees, then sing and dance about them for twenty-four Hours. Those Dancers take Care to tie Calbashes, or Gourds about their Bodies, with some Indian Wheat in them, to Rattle and make a

[1] Parkman, *op. cit.*, note on p. 207.

[2] Joutel, *op. cit.*, pp. 173–74.

noise, and some of them have a Drum, made of a great Earthen Pot, on which they extend a wild Goat's Skin, and beat thereon with a Stick. . . . . They also bury with it [the body] some store of Indian Wheat, with a Pot to boil it in, for fear the dead Person should be hungry on his long Journey; and they repeat the same Ceremony at the Year's End.[1]

OCCUPATIONS

The occupations of the Indians were closely dependent on their environment. Hunting was the chief means of support. Marquette wrote of the Illinois: "We have seen nothing like this river that we enter, as regards its fertility of soil, its prairies and woods; its cattle, elk, deer, wildcats, bustards, swans, ducks, parroquets, and even beaver."[2] Other accounts lay great stress upon the advantages of the country for the chase. Great herds of buffaloes roamed the prairies, deer were common, and wild fowl frequented the streams. The scanty Indian population could support itself most easily therefore by hunting. The French created a demand for the skins of beaver and other fur-bearing animals, and increased thereby the incentive to hunt. At certain times tribal hunting expeditions were organized, during which their village was completely deserted. La Salle's first visit to Kaskaskia took place when there was not a soul in the village. In winter commonly a great hunt of four to five months was instituted.[3] Such a life consisted of alternating periods of strenuous effort and of almost complete inactivity.

The ease of the chase and the habits it engendered discouraged agriculture. To till the soil was looked upon as demeaning labor, fit only for women and old men. "Among them the toil of sowing, planting, carrying burdens, and doing all other things that belong to the support of life appertains peculiarly to the women. The men have no other business but going to the war and hunting, and the women must fetch the game when they have killed it."[4]

Crops were raised chiefly to give variety to the food and for summer use when game was hard to secure and harder to keep. The character of the soil also was a handicap to tillage. The prairie soil is almost invariably a heavy clay loam, and in its original state was covered by an exceedingly tough sod. The white settlers had a difficult time breaking this sod, even with the aid of steel plowshares and of draft animals.

[1] Joutel, *op. cit.*, pp. 174–75.

[2] *Jesuit Relations*, LIX, 161.

[3] Marest, *ibid.*, LXVI, 253; similarly Binneteau, *ibid.*, LXV, 73–75.

[4] Joutel, *Journal*, p. 173; similarly Marest in *Jesuit Relations*, LXVI, 231.

For the Indian squaws, whose only tools were crooked sticks and stone hatchets, the cultivation of the prairie sod was an impossibility. As a result their patches of cultivated land were located along the valley, where light, sandy soil, principally derived from glacial outwash, could be found. A similar observation is reported from the South, where the Indians are said to have resided "always on light soil."[1]

The agricultural products were mostly corn and melons, to both of which the soil at their village was well adapted. While Joutel stayed at Starved Rock he says "the Indian women daily brot in something fresh, we wanted not for watermelons, Bread made of Indian Corn, bak'd in the Embers, and other such Things."[2] Father Allouez found that "they live on Indian corn, and other fruits of the earth, which they cultivated on the prairies, like other Indians."[3] The corn was stored in caches,[4] commonly located under their huts.[5] In addition to hunting and farming food was supplied by fishing, digging roots, and gathering wild fruits. Father Allouez found that "they eat fourteen kinds of roots which they find in the prairies; they made me eat them; I found them good and very sweet. They gather, on trees or plants, fruits of forty-two different kinds, which are excellent; they catch twenty-five kinds of fish, including eels."[6]

Of their arts we know little except that they bestowed some care upon the interiors of their lodges and that they used earthenware. Tonty said that on the inside their lodges were "neat, the walls or sides, as well as the floor, being finely matted." Joutel, in his account of the burial ceremony, speaks of earthen pots and earthen drums.

THE ILLINOIS TOWN KASKASKIA

The bonds which held the Illinois to their habitations were not so strong that they were permanent town dwellers, nor were they so loose that they wandered about continuously. They were sufficiently dependent on agriculture to maintain villages, around which they tilled fields and in which they stored the harvested crop. The largest of these was the town of Kaskaskia, situated just below Utica, on what is known as the Clark homestead. On the south the town bordered the river, with an indefinite extent along the water front. *Tonty's Account* thus

[1] W. Brewer, *Alabama*, note on p. 10.

[2] Joutel, *Journal*, p. 175.

[3] Shea, *Discovery and Exploration*, p. 75.

[4] *Ibid.*, Member's account, p. 93.

[5] *Tonty's Account*, *op. cit.*, p. 235.

[6] Shea, *op. cit.*, pp. 75–76.

described their habitations: "Their cabins or cottages are made with great pieces of timber, interlaced with branches and covered with bark. Every cottage has two apartments wherein several families might lodge."[1]

Marquette and Joliet found in 1674 "a village of Ilinois called Kaskasia, consisting of 74 Cabins."[2] The following year Marquette is reported as finding "the village being Composed of 5 or 600 fires."[3] Father Allouez, who came to the mission in 1677, wrote: "I found this village much increased since last year. It was before composed of only one nation, the Kachkachkia. There are now eight; the first having called the others who dwelt in the neighborhood of the Missipi. You could not easily form an idea of the number of Indians who compose this town; they are lodged in three hundred and fifty-one cabins." . . .[4] In 1680 Father Membre found "about four or five hundred cabins, each of five or six families."[5] There were about the same number of cabins when La Salle came to the village. Franquelin's map, made in 1684, recorded twelve hundred warriors. Allowing for exaggerations the accounts show that perhaps five or six thousand Indians occasionally were gathered here, and the place had the reputation among the French of a "great town." Properly the home of the Kaskaskia tribe of the Illinois, in time of a proposed campaign against hostile Indians as well as when danger threatened it became the rendezvous for all the Illinois Indians, and sometimes also for the friendly Shawanoes, Miamis, and others.[6]

The location of the great town of the Illinois was determined by geographic causes. (*a*) Mention has been made of the sandy land in the valley and of its adaptation to primitive agriculture. This is probably the largest body of such land in the upper valley, with the exception of the Morris Basin. The location of the latter was too exposed for an Indian village. Below Kaskaskia the valley was subject to inundation; above, for some distance, the areas of productive land were too small. Above the Morris Basin, at Channahon, is a similar sandy area which is also protected in its location, and here there was also at one time an Indian village of importance. (*b*) The Indians realized well the value of the broken country along the Illinois for defensive purposes. All around them lay the shelterless prairie, but here was concealment and

[1] In *Collections of the New York Historical Society*, II, 235.

[2] *Jesuit Relations*, LIX, 161.

[3] *Ibid.*, p. 189.

[4] Shea, *op. cit.*, p. 74.

[5] *Ibid.*, p. 93.

[6] *Tonty's Account*, *op. cit.*, p. 203.

protection in case of attack. In time of utmost extremity the islands in the river, or Starved Rock, were resorted to.[1] Father Allouez, who had a knack at seeing things vaguely, had its defensive location in mind when he wrote, "it has on one side a prairie of vast extent, and on the other an expanse of marsh[2] which makes the air unhealthy, and often loaded with mists; this causes much sickness and frequent thunder. They, however, like this post, because from it they can easily discover their enemies."[3] (*c*) The timbered belt along the valleys was the habitat of various wild animals. The larger game from the prairies came down to the valleys to drink. The river and its lakes and marshes were the home of waterfowl, beaver, and other water-loving animals. The location of the village was excellent therefore for hunting and trapping. (*d*) The Illinois River formed a convenient highway. It is uncertain to what extent the Illinois Indians used boats. That the river was used by them considerably, however, is indicated by the fact that their lodges were "mostly ranged on the banks of the river."[4] (*e*) Below the village navigation was possible most of the year. La Salle stated that upstream the river was not navigable in summer.[5] Charlevoix, descending the Illinois, did not find continuous navigation until after he had passed Starved Rock. At times of low water, therefore, Kaskaskia lay about at the head of navigation. (*f*) For a time Fort St. Louis afforded protection and the opportunity for trade, and thus contributed greatly to the growth and prosperity of the Indian town. (*g*) The nearness of timber for lodges and fuel, of flint for tools and weapons, of plastic clay for pottery, and of numerous excellent springs all added to the advantages of the site.

Charlevoix, in 1721, observed on the right, a league below the Fox, a high rock, which "one calls the Fort of the Miamis, because these savages have had a village upon it."[6] A century later Schoolcraft wrote: "Our guide pointed out to us the ancient sites of several Indian villages, one of which was situated on the top of a romantic tabular elevation, called the Buffalo Rock."[7] Of this Miami village little else is known. It was located probably chiefly for defensive purposes, but had in a minor degree most of the advantages of Kaskaskia. The soil on Buffalo Rock is also sandy to a large extent.

[1] See pp. 53 and 64.

[2] Now occupied by the Illinois and Michigan Canal.

[3] Shea, *op. cit.*, p. 74.

[4] Allouez, in Shea, *loc. cit.*

[5] Margry, *Découvertes et Établisements*, II, 174–75.

[6] Charlevoix, *op. cit.*, VI, 119.

[7] Schoolcraft, *Travels in the Mississippi Valley*, p. 322.

THE FATE OF THE ILLINOIS—STARVED ROCK

A numerous and warlike race in the time of La Salle and Tonty, the Illinois shortly after were overtaken by disaster. The rapid and complete ruin of this once proud people may be ascribed directly to the licentiousness that became common among them,[1] to wasting wars with other Indian tribes, to the appalling crime of one of their number, but also to the unprotected character of their country.

The first blows which weakened the tribe were delivered by the Iroquois. From their forest fastnesses in the East the ferocious savages of the Five Nations swept down again and again upon the prairie Indians, scattering them widely, occasionally driving them even beyond the Mississippi, as in the raid on the Illinois experienced by Tonty. The reason for these attacks is to be found chiefly in the fur trade and the growing hostility between the French and English. The Five Nations sold their furs to the English. The western Indians for the most part traded with the French, through the great fur depot at Michilimackinac. The ambitious Iroquois "hoped, by penetrating to Michilimackinac, to make themselves the agent or medium for the trade with the tribes near it, so that they could control the whole southern traffic."[2] The Illinois, who had cast in their lot entirely with the French, felt the full hostility of the Iroquois, especially after the abandonment of Fort St. Louis.

The destruction of the Illinois was hastened by the immigration of other tribes, driven out of their homes by the Iroquois. Their rich hunting grounds were disputed by these other nations, and numerous quarrels ensued. It appears that by 1694 the old village was at least temporarily abandoned and that the Kaskaskia tribes had joined their Peoria kinsmen on Lake Peoria.[3] By 1700 the Kaskaskias had parted company with the Peorias and taken up their abode on the Mississippi in the district which still bears their name.[4] Here it was easier for the French to protect them, and here also the ground was less disputed. Marest, speaking in 1712 of the Illinois country in general, said, "in a very great extent of Country, scarcely three or four Villages are found."[5] Their decay had proceeded so far by 1721 that Charlevoix spoke of "the little that remains of this Nation."[6]

[1] Parkman, *Conspiracy of Pontiac*, pp. 30, 521.

[2] Winsor, *Narrative and Critical History of America*, I, 303.

[3] Gravier, in *Jesuit Relations*, LXIV, 158 ff.

[4] *Ibid.*, LXV, 100–103. [5] *Ibid.*, LXVI, 218. [6] *Op. cit.*, III, 393.

Against superior numbers of unforeseen attacks the prairie homes of the Illinois afforded little protection. Their only line of defense was the broken and wooded country along the Illinois. Once this was gained by the enemy, the only remaining salvation lay in braving a siege on Starved Rock or in dispersal across the prairies. In the raid witnessed by Tonty the Illinois used the river as a line of defense. Once the Iroquois had forced its passage, however, the defenders were put to headlong flight. After the withdrawal of the main body of Kaskaskia Illinois to the Mississippi, a number found their way back to the old, favorite site. Charlevoix, in 1721, came upon a considerable village in the shelter of Starved Rock.[1] This settlement was attacked in the following year by Outagamis and made a stand on Starved Rock until relieved by a party of French.[2] A subsequent siege of different issue, according to popular tradition, gave the rock its present name.

In 1769 an Illinois Indian assassinated Pontiac. "This murder, which roused the vengeance of all the Indian tribes friendly to Pontiac, brought about the successive wars, and almost total extermination of the Illinois nation."[3] There is a legend, long current, that a part of the Illinois tribe met its doom on Starved Rock, probably in consequence of the feud resulting from the death of Pontiac. The story as told more than a century ago has it that Starved Rock "many years ago was the scene of a desperate conflict between the Pottowattomies and one band of the Illinois Indians. The latter fled to this place for refuge from the fury of their enemies. The post could not be carried by assault, and tradition says that the besiegers finally succeeded, after many repulses, by cutting off the supply of water. To procure this article the besieged let down vessels attached to ropes of bark from a part of the precipice which overhangs the river, but their enemies succeeded in cutting off these ropes as often as they were let down. The consequence was a surrender, which was followed by a total extirpation of the band."[4] Another tradition ascribes the taking of the stronghold to starvation. Thus was the rock where once stood Fort St. Louis renamed Starved Rock. Old inhabitants insist that in earlier years human bones lay bleaching on the top of the rock, and several local historians accepted this evidence.[5] It is altogether reasonable that in

[1] *Op. cit.*, VI, 119. [2] *Ibid.*, IV, 233–34.

[3] Nicollet, quoted in Parkman, *Conspiracy of Pontiac*, II, 312.

[4] Schoolcraft, *Travels in the Mississippi Valley*, pp. 319–20.

[5] Davidson and Struve, *History of Illinois*, p. 36.

the hour of their greatest danger a remnant of this once illustrious tribe should have sought refuge where their French protectors and their own ancestors had found a sure defense.

PERMANENT SETTLEMENT OF THE ILLINOIS VALLEY

During the eighteenth and part of the nineteenth century this region remained almost unvisited by white men, its very existence almost forgotten. During this time the French title was extinguished, but its Anglo-American heirs were slow to possess it. Of the various factors which restrained the Americans to their seaboard settlements for so long a time the most important was the Appalachian mountain barrier, which held the population back until at last it was forced to overflow into the interior plains. Once this overflow set in it spread over the new lands of the West in a great flood.

PIONEERS FROM THE SOUTH

The first American settlers were frontiersmen from the South. Most of them came from Kentucky or Tennessee, but at an earlier date had come from Virginia or the Carolinas. Favorably situated passes directed them across the mountains into the former states. For the most part they were men who wanted much elbow-room, range for their stock, and hunting grounds. They spread rapidly along the Ohio Valley. This river became a great highway of frontier travel, distributing the settlers through southern Ohio, Indiana, and Illinois. From southern Illinois their settlements extended up the Mississippi and the Illinois Valley to its head. In the late twenties a number of pioneers had established themselves in La Salle County. Several families lived in South Ottawa, and one was at Bailey's Grove, opposite Deer Park, in 1825. In 1832, when the Black Hawk uprising broke out, there were about fifty people in the lower Fox Valley and about Ottawa; four or five families lived near La Salle and Bailey's Grove, and about three each in Vermilion and Deer Park townships. This was the feeble vanguard of civilization, which was soon to establish itself permanently.

The most striking feature of this southern immigration was its establishment along valleys. A map of these early settlements would show long digitate fringes along the stream courses. This location was in part a response to the shipping advantage of the rivers. The southern pioneers chose homesteads along valleys, however, even when the streams were not navigable, as in the case of the Big Vermilion, at Bailey's Falls and at Deer Park. Their cabins were built usually on the slopes

of the valley, at a spot where a spring issued. They also chose the valleys because they were timbered. They knew the qualities of the forest soil and the methods of cultivation in clearings, but were distrustful of the treeless prairies whose nature they did not understand.

INFLUX OF NORTHERN SETTLERS

Largely because of their industrial interests overpopulation did not come about in the northern seaboard states as early as in the South, and emigration began at a later date. The settlers from New England and New York first occupied the region marginal to the Great Lakes. The peninsula of Michigan obstructed settlement for a short while. By 1832, however, boat connections between Buffalo and Lake Michigan points had been established regularly, and in that year emigration to northern Illinois set in in full force. Of this northern influx the upper Illinois Valley received its full share. For this its nearness to Chicago, the port of entry, was largely responsible. The first settlers avoided the sandy plains about Chicago and selected more desirable sites in the fertile country west of the lake. Again, the timbered belt of the Illinois attracted the emigrants and was soon occupied throughout its entire length. Early northern colonies were located at Ottawa and near La Salle. Utica was also settled at an early date, as well as the timbered belt of the Big Vermilion.

The few southern families were soon surrounded by northern neighbors. In a list of settlers of La Salle County, made in 1877, eighty had come from New York and New Jersey, fifty-eight from New England, fifty-nine from Ohio (largely from New England originally), thirty-one from Pennsylvania, and only twenty-one from all the states of the South. Certain rural communities of La Salle County are composed to this day of purer Yankee blood than are most parts of New England. Social institutions still bear the stamp of their Puritan origin.

CONQUEST OF THE PRAIRIE

The first settlers found the upland covered with tall grass, in places as high as a man, an almost endless sea of green or brown. Trees and bushes were confined to the valleys, much as at present, and possibly were even less extensive. The neglect of the prairies was in part the result of superstitions concerning it which had gained currency. Early travelers considered it little better than a desert. The most famous opinion delivered upon them was by James Monroe: "A great part of the territory is miserably poor, especially that near lakes Michigan &

Erie & that upon the Mississippi & the Illinois consists of extensive plains wh have not had from appearances & will not have a single bush on them, for ages. The districts therefore within wh these fall will perhaps never contain a sufficient number of Inhabitants to entitle them to membership in the confederacy."[1] In less than a century after this prophecy was made Illinois had a population approximately twice as dense as that of Monroe's native state, Virginia. The belief in the poverty of the soil seems to have been based solely upon the absence of timber. Men from the wooded East were wont to judge the merits of land by the kind and luxuriance of its trees, and they considered the prairie a barren heath. Another prejudice was concerned with the winter climate. Wintry blasts, sweeping the shelterless grasslands, were pictured as bringing with them temperatures that neither trees nor human beings could endure. Since these adverse opinions were based upon ignorance, a short habitation of the region sufficed to dispel them.

Long after all prejudice was gone, however, the prairies still baffled settlement. The pioneer commonly had brought with him a small, weak plow from his hill farm in the East. At best his work animals consisted of a span or two of horses or of a few yokes of oxen. With this equipment the breaking of the prairie sod was a task beyond his power. Within a few years there was placed upon the market a plow of heavy steel of improved pattern, adapted especially to cutting and turning the heavy prairie sod. By that time also the farmers' stock had increased, and the necessary animals were available. The breaking was done usually with six horses or a greater number of oxen.

Prairie fires were a source of considerable danger, especially in autumn. A prairie fire once started often swept for miles over the flat surface faster, it is claimed, than a man could ride. Thus in some cases the harvest of a year's toil and even the homestead itself were destroyed. As a consequence settlement was retarded through fear of these fires. As a means of protection against them the pioneer who had ventured out on the prairie sought protection by plowing a broad strip about his fields, or at least about his buildings. But until the prairie grasses had given way to cultivated crops the danger from prairie fires was not entirely overcome.

Because of the absence of surface water the prairie was at first considered waterless. It was discovered after a time, however, that at slight depths good well water could be obtained in buried glacial gravels in quantity sufficient for the needs of the homesteader.

[1] *Writings*, I, 117.

Perhaps the most serious drawback was the lack of timber for fuel, buildings, fences, and the many other needs of the farm. This handicap did not affect the prairies of the Starved Rock vicinity, because they lie within convenient distance of the wooded valley slopes. It did prevent the opening up of the more remote townships of the county, some of which remained virtually uninhabited until railroads were laid through them.

The prairies were at one time in evil repute because of their unhealthful character. The earliest settlement at La Salle was broken up by "fever and ague." Malarial ills were the bane of the pioneer prairie farmer. Other fevers, probably mostly typhoid, were also common. The sickness among the prairie settlers was due in part to ignorance of the new conditions of life, but especially to a neglect of sanitation. Probably credence must be given as well to the theory of "poisonous miasmas" that were said to rise from the prairie. Much of the land was ill-drained and contained foul swamps and stagnant pools from which malaria and probably also typhoid was disseminated readily. The bodily resistance of the pioneer, often underfed and overworked, also was low and made him susceptible to disease.

The conquest of the prairie did not consist merely in breaking the heavy sod and sowing the crop in the rich black earth. It required the solution of each of these difficult problems. The task was slow and arduous and put to the mettle the best qualities of the newcomers through years of privation and of unremitting application. The splendid prairie farms of the present day, which support their owners in comfort, are a monument to that first generation which carried the stubborn contest against adverse conditions to a successful end.

PIONEER LIFE

The first improvement made was a shelter for the household. A log cabin was built according to the conventional design of the frontier. The furnishings of the cabin were also usually homemade, from the built-in one-poster bedstead to the three-legged stools. Almost none of the old homesteads remain. They were put up rudely and hastily, temporary shelters that were converted to meaner uses when the farmer had established himself.

That crops were grown at all in those first years is due only to the liberality of the soil. The first crop was almost invariably corn, planted in the half-rotted sod, often by gashing it with an ax. Until the sod was decomposed it was difficult to raise the small grains. Later most of the

farmers began to raise wheat, and to some extent barley. Farming methods remained crude and inefficient for a number of years, and smaller yields than at present were the rule. Only after land values rose considerably did improved methods of cultivation receive attention. The farmers of this vicinity took their corn and wheat largely to the mills at Dayton, Lowell, or Ottawa. When the roads were impassable the farmer or, more commonly, his wife pounded the corn to meal in a hand mortar.

Almost as soon as their cabins were built the settlers began the erection of schools and churches. In 1830 Ottawa built its first courthouse. The early development of well-ordered social institutions is in marked contrast to the settlements made by southerners. The northern settlers were accustomed to community life, and the social habits which it had engendered they carried with them to their new homes.

THE DEMAND FOR IMPROVED COMMUNICATION

PIONEER TRANSPORTATION

At first the settler paid little heed to transportation problems. As long as the farm yielded no great surplus the pioneer had little interest in markets or in roads to them. In those days the prairie itself served as highway and was crossed at will in any direction. Some of these uncertain trails followed Indian or Buffalo paths; others were worn gradually between settlements. Entirely unimproved, these roads were impassable in early spring and after heavy rains. Bridges were unknown; all streams had to be forded. Floods isolated settlements for days, and even resulted in loss of life. Before the Big Vermilion was bridged a number of people lost their lives while attempting to ford it.

By the middle thirties the settlers were raising a considerable surplus and the question of transportation engaged their attention. The best market was at Chicago, and great quantities of grain were hauled there from the upper Illinois Valley. The wagons often were accompanied by droves of live stock. This traffic soon outlined roads that took the shortest course across the prairie. South of the park one of these old diagonal roads has been preserved from Vermilionville to Ottawa. At the latter place this road joined the main traveled Chicago road, which leads northeastward and is now an automobile route of importance.

Another early means of shipping was by steamboat. The first steamboat entered the upper Illinois in 1831. For a number of years thereafter only occasional arrivals are reported. Starved Rock was visited

only at high water, and even then rarely. At such times boats landed also at Utica, and now and then boats ran up to Ottawa but not beyond. The only regular port before the opening of the canal was Peru, which had both a deep channel and a good landing and for a time enjoyed a flourishing traffic. The principal markets reached by the steamboats were St. Louis and New Orleans, both of which commonly were glutted with agricultural produce. With reference to both of these places the upper Illinois country occupied a remote position. For these reasons its river traffic was never great.

"BOOM DAYS" AND THEIR COLLAPSE

When the worth of the prairie soil was proved the early skeptical attitude yielded rapidly to strong confidence in the future of the region. Well-based confidence grew to wildest enthusiasm. The years of trial were followed by a period of exaggerated optimism in which all values became inflated to an extreme degree. Farm lands increased rapidly in price, but their rise was eclipsed by that of town lots. The resources of the land were held to be so great that the mere location of a town site would insure the immediate establishment and rapid growth of a city. Every existing settlement saw itself destined to greatness. Peru was heralded as about to "become one of the greatest inland towns in the West, and second only to Chicago," and prices of from five to ten thousand dollars an acre were asked in the then poor and struggling village.

Speculation reached its most feverish character in certain town sites which never passed beyond an existence on paper. Crossroads were considered a sufficient reason for promoting a town. Even Starved Rock was not overlooked by the "land sharks." Here they planned the "City of Gibraltar," unmindful of the fact that the name fitted the site better than did their plans. Admirable as was the location of Starved Rock for a fort, it was impossible as a town site, with its narrow valley terrace and surrounding bluffs. No improvements were ever undertaken. The project merely raised Starved Rock momentarily out of the obscurity in which it had lain for a century and a half.

The new state was sorely in need of efficient means of transportation. The wealth of the state was boundless, so it was argued, and warranted the immediate construction of waterways and railroads for the entire state. An ambitious project of internal improvements was adopted, including provision for a canal from Lake Michigan to the Illinois River, for the purpose of linking the Mississippi River and the Great Lakes.

The whole vast scheme was undertaken at once. In four years from the time the first money was voted for these improvements the state was virtually bankrupt and had ceased paying interest on its debt. When the improvement enterprises were abandoned the credit of the state was ruined, business had almost ceased, and specie had disappeared. Worst of all, immigration naturally avoided a state so burdened with debt that its inhabitants seemed destined to perpetual oppression by excessive taxation. A conservative administration in 1842 began the arduous task of restoring the fallen fortunes of the state. The Illinois and Michigan Canal, as the most necessary of the projects, was completed and was of greatest importance in giving new life to the development of Illinois.

ILLINOIS AND MICHIGAN CANAL

The abandoned glacial outlet of Lake Michigan suggested the possibility of constructing a canal between Lake Michigan and the Illinois to the early French explorers. Thereafter the plan reappeared in various forms from time to time. The construction of the canal was finally undertaken in 1836 in response to the very urgent demands of the pioneer communities of Illinois for direct communication with the eastern markets. In 1839 work was abandoned owing to the general depression in the state, and the canal was not completed until 1848. The canal stretches along the northern side of the Illinois Valley and is plainly visible from Starved Rock.

Canal traffic.—The canal immediately became the most important passenger carrier between Chicago and points west and south. Graceful and well-appointed packet boats provided a degree of comfort hitherto unknown in western travel. These boats made the trip between Chicago and Peru in twenty hours, a little less than the time required by stage. In 1853, however, the railroad along the valley was completed, and by reason of its superior speed and lesser charges ruined the packet service. In that year the boats were sold and passenger traffic was abandoned. At the time of its opening there was neither canal nor railroad to compete with the Illinois and Michigan Canal. It therefore was the one great artery for freight traffic, not only for the Illinois country, but also to a considerable extent for regions to the south and west.

With temporary exceptions corn was the principal commodity shipped out by way of the canal. The heavy prairie soil grew corn with better success than any other crop. Previous to the building of the canal, however, its bulk had made it unprofitable except for home consumption, and wheat, being of less bulk relative to its value, was the chief cash crop.

The canal, by reducing the cost of shipping, made corn the most profitable crop of the prairies. As a result the production of corn increased tremendously, whereas the growing of wheat was almost abandoned. Coal produced along the Illinois River held second place in tonnage of exports.

Among the commodities shipped in, lumber, the chief deficiency of the prairie, was foremost. The first canal boat that came to Ottawa was loaded with lumber. This boatload reduced the local price from $60 to $30 per thousand feet. Previously most of the lumber had been shipped from New York and Pennsylvania by way of the Ohio, Mississippi, and Illinois rivers. The canal made white pine from Michigan available at prices with which the older supply could not compete. Salt was another necessity of the prairie that had to be imported. The canal enabled the salines of western New York to supply the local market at prices much lower than had obtained previously. Cheaper salt encouraged stock-raising. After the opening of the canal the stores of northern Illinois were supplied from Chicago, whereas previously their goods had been shipped up from St. Louis by river. Shipments of the most varied sort were sent through the canal, which formed a link in a vast system of waterways, extending from the Gulf to New York. Grain from western Illinois, Missouri, and Iowa, and lumber destined for points west and south, were the principal items. There were also barges piled high with bales of cotton and with hogsheads of sugar, molasses, and tobacco, which were sent from southern plantations to northern markets by this route.

Services of the canal.—In its day the Illinois and Michigan Canal contributed more than any other influence to the growth of northern Illinois. Previously the farmer had raised little more than his wants demanded because of the inaccessibility of markets. The canal, it is estimated, reduced the cost of shipping grain from the vicinity of La Salle to Chicago 39 cents a bushel. Cheaper freight was an incentive to the cultivation of larger areas with better care. The increased value of farm products resulted in a sharp rise in land values. Estimated on the basis of the same crop of wheat grown at the same expense, it was claimed that the canal made the land about Starved Rock equal in value to that at Columbus, Ohio, and worth $37.50 more an acre than similar land at Iowa City.

Homemade goods disappeared after the opening of the canal. It was no longer necessary to grind meal at home nor to fashion rude furniture from the timber at hand. Food, clothing, implements, and

household furnishings became more diversified. Especially in the introduction of more of the comforts of life did the canal aid in breaking down the isolation and hardships of pioneer conditions.

The first large foreign-born element was introduced in the construction of the canal. The laborers were mostly Irish and, under the primitive methods of the time, were employed in great numbers. From 1830 to 1843 most of them were out of work and many were unable to leave. Their savings were largely in the form of canal scrip, which fell in value to sixteen cents on the dollar. It was accepted, however, at par in the purchase of canal lands. Out of dire necessity many of the Irish bought land and turned to farming. When the good years came they found themselves possessed of valuable property. The first settlements of this sort formed, other countrymen were attracted, and as a result the canal counties have to this day an unusually large Irish population.

Towns grew up at favored locations on this highway of commerce. La Salle became the river terminus of the canal. Peru nominally occupied this position, but because of the character of the flood-plain the "steamboat and canal basin," which served as harbor, was built above Peru; here La Salle was laid out in 1837. The original village of Utica was on the river about where the road to Starved Rock crosses. Utica hoped to secure the terminus of the canal and charged corruption when the legislature located it at Peru. The charge probably was ill-founded, as the troublesome character of the Vermilion shoals was well known at the time and was thought to make an extension below the obstruction in the river necessary. When the canal was built along the base of the northern bluff the old location became exceedingly unsatisfactory. North Utica was laid out on the canal in the year 1852 and the older settlement was abandoned. The chief occupation of Utica has been the manufacture of hydraulic cement from its Lower Magnesian limestone. This industry was begun during the construction of the canal, which consumed great quantities of the product.

Railroad competition and decline of the canal.—Five years after the completion of the canal a railroad was built parallel to it. The struggle which ensued ended in the complete triumph of rail carriage and the virtual abandonment of the canal. The first loss suffered by the canal was that of the passenger traffic; next the merchandise freight was taken over by the railroad. After 1865 the canal tolls declined gradually, and from 1882 its tonnage decreased as well. At present the canal is used virtually only by pleasure craft.

The advocates of the canal believed that rail carriage could never compete with it. Yet the railroad passed the canal easily, and after a time took virtually all the traffic. (*a*) Transportation by canal was slow. The horse could not compete with the locomotive in the carriage of passengers or of goods which were to reach their destination quickly. (*b*) The canal was a link between the Great Lakes and the Illinois River, and as such was dependent largely on the conditions of navigation in these bodies of water. The Illinois was subject to great variations in volume; in summer especially the water was often too low for navigation. Usually the periods of low water coincided with the harvest, when great quantities of grain were brought to the river for shipment. (*c*) River, canal, and lake traffic suffered from lack of organization. Most of the boats ran without regard to each other and without schedule or regular tariff. Articulation between the water routes was also lacking. Most through traffic had to break bulk at both ends of the canal. (*d*) The canal was closed by ice from three to four months of every year. This meant the total loss of all winter shipping. (*e*) The canal was built on an inadequate pattern and did not meet the demands of the region even at the time of its construction. It had a minimum depth of 56 inches; locks were $17\frac{1}{2}$ feet long; occasional wide waters allowed boats to pass. Towage was entirely by mules and horses, which crowded each other on the towpath. Had the upper Illinois country been forced to rely on this means of transportation hopeless congestion would have prevailed. Thus, partly because of lack of foresight in its plan, more largely because of poor business practice, and in part because of geographic disadvantages, the canal gave way to the railroad, and is today in part a reed-choked series of pools, an outworn remnant of pioneer days.

RAILROAD CONSTRUCTION

In 1850 the Rock Island & La Salle Railroad was chartered to connect the terminus of the canal with the Mississippi River. The road as planned at first was not to compete with the canal and river but to supplement them. Soon, however, a continuation was authorized to parallel the Illinois and Michigan Canal, giving all-rail connections between Chicago and the Mississippi River. The road was opened between Chicago and La Salle in the spring of 1853 and immediately became a successful competitor in the traffic of the upper valley.

The local line of the Illinois Central was intended to be the great trunk line of the state. The road was projected to run from the mouth of the Ohio north to the Wisconsin state line. It crossed the Illinois

Valley at La Salle (*a*) because of the terminus of the canal, and the transshipment business which it was hoped to secure at that point, and (*b*) because the two Vermilion valleys, lying opposite each other, give easy access from the elevated prairie. The road reached no market of the first class, and the canal did not bring the expected business with Chicago. As a result a branch was built to Chicago, then one to St. Louis, and gradually these branches became the main line. The old main line, on the other hand, was reduced to the condition of a feeder for the east and west lines. At present it carries considerable way-freight, but has a restricted passenger traffic.

The trunk line of the Chicago, Burlington & Quincy Railroad lies north of the Illinois Valley, which it parallels at a sufficient distance to avoid bridging most of its tributaries. It has built or acquired numerous feeders, two of which cross the Illinois, one at La Salle by way of the Big Vermilion, the other at Ottawa. Both draw upon the rich farm lands and coal fields of southern La Salle County.

In 1907 the Chicago, Milwaukee & St. Paul Railway was extended to Portland, across from Deer Park. The road operates a large mileage in Wisconsin and Minnesota, states deficient in coal. La Salle and Bureau counties contain the most northerly coal beds in Illinois, and hence those nearest the territory served by this railroad. This branch was built to tap the local coal field and the Portland cement district on the Big Vermilion River.

The Chicago, Ottawa & Peoria Railroad (electric) is a response to the increasing concentration of population in the Illinois Valley. It carries on a brisk interurban traffic between Joliet and Princeton, and maintains also branch lines to Streator and Ladd.

On the one hand the fertile soils, the level surface, the linear character of the Illinois Valley, and the abundance of coal and road metal have invited the construction of railroads. In their turn the railroads have made possible the development of the prairies, have attracted immigration, and have developed industries, so that the district about the state park is now one of the foremost industrial centers of the state. Foreign immigration was directed to this region for the most part by the railroads, directly or indirectly. The Illinois Central, especially, financed by a land grant, carried on a vigorous advertising campaign, in which it set forth the richness and cheapness of its lands. At this time thousands of people were coming to America from Europe. Many of them were diverted into industrial and commercial occupations in the eastern states, but many more drifted west, where there was still

cheap land. These were especially natives of Northern Europe; those who came to La Salle County were Germans above all, then Scandinavians, and lesser numbers of English, Dutch, Flemish, and others. They were mostly of peasant stock and land-hungry. Their ancestors had been tillers of other men's soil for the most part; their one ambition was to become freeholders. In many parts of La Salle and adjacent counties the foreign-born outnumbered the native settlers even before 1865. The prairie south of Starved Rock is inhabited largely by the sons and grandsons of German and Scandinavian immigrants. Many of them own splendid farms and are wealthy. Their thrift and stability are valuable assets to the region.

MINES AND FACTORIES

There are three industrial districts in the vicinity of Starved Rock. The largest of these has La Salle as its center and extends from Portland, on the Big Vermilion, to Depue, on the bend of the Illinois. South of Starved Rock is the Streator region with its collieries and factories. On the east, Ottawa and Marseilles form a smaller industrial district.

COAL MINES

The distribution of coal mines is determined by the anticlinal structure of the bed rock. Upon the crest of the fold the "Coal Measures" are wanting, and on its flanks they are poorly developed. A bit of poor coal can be found upon the bluff back of Starved Rock, but it is of almost no commercial value. Almost all the county lying north of the river is underlain by formations older than the "Coal Measures" and hence without coal. East of Starved Rock the nearest coal beds of great commercial importance are in southeastern Grundy County, almost fifty miles distant. West and south of Starved Rock the situation is radically different. Here the rocks dip sharply and good coal is within sight of the crest of the fold. One coal mine is on the right bank of the Vermilion, below Deer Park Glen. Others are situated across the river at Portland. Thence westward, beyond the limits of La Salle County, from four to five seams of coal underlie the prairie. The seam worked most largely is the Third Vein Coal, which averages about three feet thick. About 140 feet higher is the Second Vein, and 40 feet above it is the First Vein. Both have been worked to some extent. In this western area the coal is buried deeply beneath the surface, and shafts from three to four hundred feet deep are sunk. The local coal enjoys an excellent reputation

and is shipped out in large quantities, especially to Chicago and the North, for steaming purposes.

Outcropping beds of coal were worked in early years at Ottawa; at Lowell, on the Vermilion River; and at Split Rock, above La Salle. In 1853 coal was discovered underground at La Salle, and two years later the first shaft was opened. Both La Salle and Peru soon found greater profits in coal-mining than in farm trade or canal traffic. The most phenomenal growth of mining in the county took place at Streator, where the coal was found to be unusually thick. In less than twenty years from the sinking of the first shaft this place had grown from an insignificant village to the largest city in the county. The latest development has been along the line of the new St. Paul branch road. In 1913 La Salle held fourteenth place among the coal-producing counties of Illinois, with a production of 1,382,945 tons. Of this amount La Salle city was credited with 797,699 tons, or more than half. The rich beds at Streator are being exhausted, and this place had in that year a production of only 464,041 tons. One mine at Oglesby (Portland) produced 204,222 tons. The total number of miners employed in the county was 2,895, of which 1,498 were credited to La Salle, 865 to Streator, and 426 to Oglesby.[1] For this rough and rather uncertain employment foreign labor mostly is used. Italians, Poles, and other Slavic races are represented most numerously.

GROWTH OF INDUSTRIES

The first industrial establishments of the region were water-driven mills of various sorts. The period of active industrial development began about half a century ago, coincident with the mining of coal on a commercial scale. The presence of good coal has been the principal stimulus to the growth of local manufactures. La Salle and Streator, the chief coal-mining centers of the county, also lead in manufactures. The region possesses additional advantages for industrial enterprise. Numerous railroads supply good transportation, and the canal, although little used, is still a potential competitor. The region possesses raw materials used in various industries, as in the cement mills of Portland and the fire-brick works of Utica. The increase in industrial plants has created a good supply of labor, which has become a stimulus to further industrial enterprise. The lower cost of real estate and of taxes has favored the dispersal of certain types of industry from Chicago into this section. Finally the central location of this region in the corn belt

[1] *Coal Report, Illinois, 1913*, pp. 14, 22–25.

has given it a certain advantage, not highly localized, however, in the manufacture of articles such as agricultural implements.

The hydraulic-cement industry of Utica goes back to the building of the canal. For many years the village prospered because of the Prairie du Chien limestone on which it is situated. This rock contains lime carbonate and clay in the proper proportions to form cement when burned. For use under water it has long enjoyed an excellent reputation. In recent years the scientifically compounded Portland cement, superior because of its greater uniformity, has replaced the older "natural" article, and Utica's historic industry has been crowded out. At present the manufacture of fire brick is making good to some extent the loss of the cement industry. The clays used in making fire brick are derived largely from the bluffs west of Starved Rock and for a time were taken from pits now located within the park.

Portland is the youngest city of the county. In less than ten years it grew from an insignificant hamlet to a flourishing city with a population of 3,194 in 1910. The story of Portland is geological. The highest rock here is the La Salle limestone. Immediately beneath it lie soft clays, clay shales, and a thin seam of coal. At a greater depth is more and better coal. The association of coal, limestone, and clay gives all the requisites for the manufacture of Portland cement at minimum expense. The limestone is quarried, and the clay and coal beneath it are dug out of the same pit. More coal is furnished by shafts close at hand. The ground limestone and shale are mixed and fired by means of the coal. An added advantage is the small amount of stripping necessary. As a result of these conditions the industry has thriven to an unusual degree. The product of the mills here and at La Salle finds a large sale, not only in Chicago and the surrounding prairie regions, but also in more distant places.

The smokestacks of La Salle and Peru, which form a familiar sight from Starved Rock, belong mostly to zinc smelting and refining plants. Since 1858 this has been the dominant industry of the Twin Cities. Again, a peculiarly favorable geographical location is largely responsible. In the early days of the industry the zinc ore was derived from the mines of southwestern Wisconsin and northwestern Illinois. In the smelting of zinc more fuel than ore is required. The concentrates of ore were shipped accordingly to the nearest coal field on the way to market. This was the coal basin of the upper Illinois Valley. Later zinc from the Rocky Mountains and southwest Missouri also found its way to the local smelters.

Ottawa, although the oldest city, has not developed industries on the scale of the cities in the vicinity of Starved Rock, chiefly because of the absence of good coal. One of the oldest industries is the manufacture of agricultural implements. The making of glass has been the most noted industry of the city. Ottawa lies in the heart of extensive outcrops of the St. Peter sandstone, the sand of which is of high quality and easily accessible. Within this area sand pits line the tracks of the railroads along the bluffs of the Illinois and Fox rivers. It is this industry which threatened the destruction of Starved Rock and hastened the creation of the state park.

For the last half-century the growth of population in La Salle County has been due almost entirely to the advance of its manufactures and mines. Since 1870 most of the rural districts have lost steadily in population. The increased use of farm machinery and the gradual increase in the size of the farms have released a part of the population that previously found agricultural employment. Table I shows the changes in population in the townships and in the cities and villages of the Starved Rock region.

TABLE I

	1890	1900	1910	Remarks
Deer Park Township	802	851	827	Composed of large prairie farms
Farm Ridge Township	1,110	1,119	1,068	Rural conditions
Utica Township	1,568	1,582	1,342	Rural, includes Utica village
Vermilion Township	556	550	507	Rural
La Salle	9,855	10,446	11,537	Continued industrial growth
Ottawa	9,985	10,588	9,535	Industries of secondary importance
Peru	5,550	6,863	7,084	Industries increasingly important
Portland			3,104	Purely industrial
Streator	10,880	13,440	13,035	Growth checked by decreasing productivity of coal mines

These figures show that year by year this region is becoming dependent more largely on industries and that its growth is localized in a few favored places, principally those that combine coal and good transportation. The prairie farms are as productive as ever and more profitable than at any previous time, but they no longer dominate the economic and social life of the county.

STARVED ROCK STATE PARK

At the settlement of the region Colonel Hitt entered Starved Rock and the bluffs adjacent. Other parts of the present park were taken up by various settlers. At that time the bluff lands were valued chiefly as wood lots. For long years this tract had a quiet and useful existence devoid of romantic attachments. Cattle browsed along the margins of the bluffs and occasionally timber was cut to supply farm needs. The growth of public interest in Starved Rock was very slow. When Francis Parkman visited Utica in the sixties he found very little known of its history. As long as agricultural interests were dominant Starved Rock attained to no higher dignity than that of an occasional picnic ground. The growth of cities near by and the improvement of transportation facilities gradually attracted holiday excursionists to the place. In 1890 Walther secured the property, soon erected a hotel, and formally inaugurated Starved Rock as a summer resort. The venture was reasonably successful from the outset. Attendance grew, especially after the interurban railway was built. The ferry that serves Starved Rock from the electric line handled in its first five years the following number of people: 1904, 22,000; 1905, 31,000; 1906, 41,000; 1907, 41,000; 1908, 36,000.[1] In 1910 a second resort was opened by the Illini Club at Pulpit Rock.

At about the same time that Starved Rock and surroundings were capitalized for resort purposes several neighboring areas became recreation grounds. Beautiful Deer Park Glen was purchased by Matthiessen, a La Salle capitalist. Extensive improvements, especially roads and shelters, were provided and the grounds opened to the public. Because of the liberal attitude of the owner Deer Park has enjoyed the highest popularity with the public for years. Buffalo Rock has had a more varied career. Long a local scenic celebrity, about fifteen years ago it became the headquarters of a religious sect. Unsuccessful as a bulwark of religious dogma, it was next occupied by the Buffalo Rock Tent Villa Company for the outdoor treatment of tuberculosis. At present a great manufacturing establishment, the Crane Company of Chicago, has made a playground of a part of Buffalo Rock for its employees and is reaping a substantial reward in the increased vigor and cohesion of its personnel.

The increasing commercial exploitation of the Starved Rock vicinity and the danger of the glass industry, especially to the upper canyons,

[1] *Illinois Park Commission*, 1911, p. 28.

led to an agitation for the acquisition by the people of Starved Rock and the canyons immediately about it. In this movement the Geographic Society of Chicago, the Prairie Club, other organizations, and numerous individuals participated. The Forty-sixth General Assembly of the State of Illinois took up the matter and authorized the governor to appoint a park commission "to make investigation of Starved Rock and its contiguous territory, to ascertain its adaptability for the purposes of a state park, also to make a report respecting Starved Rock, and respecting other regions desirable for park purposes." The commission found Starved Rock to possess the four most desirable requirements of a state park in (*a*) accessibility, (*b*) size, (*c*) moderate cost, and (*d*) decided and uncommon claims. In addition, the body emphasized the peculiar geologic, historic, and nature-study interest of the region. It also called attention to the "native wildness and ruggedness" as attractions and urged their preservation "with nature as little modified as possible." A recommendation was presented to the legislature for the purchase of "the Starved Rock property and the canyons and picturesque lands along the south bank of the Illinois River for a distance of about four miles up the river from Starved Rock, comprising in all about 1,000 acres, for a state park and forest preserve for the use of the inhabitants of the state for park purposes, and as an object-lesson in forest preservation."[1]

The legislature responded by passing the act providing for the purchase and maintenance of the Starved Rock State Park, approved June 10, 1911. A permanent park commission was established and ordered to secure a tract of land containing about 1,155 acres. For the government of the park the following paragraphs relative to misdemeanors were included:

§ 7. Any person who wilfully destroys, cuts, breaks, injures or removes any tree, shrub or plant within any State park shall be guilty of a misdemeanor, and on conviction shall be punished by a fine of not less than ten dollars and not more than one hundred dollars, and shall stand committed to the county jail until such fine and costs are paid.

§ 8. Any person who wilfully destroys, mutilates, injures or defaces any guide-post, sign, notice, tablet, fence, railing, enclosure or other work for the protection or ornament of any State park shall be guilty of a misdemeanor, and on conviction may be fined in any sum not exceeding five hundred dollars, or be imprisoned in the county jail not exceeding three months, or may be punished by both such fine and imprisonment in the discretion of the court.

[1] *Report of the State Park Commission*, 1911.

§ 8½. It shall be unlawful to sell, distribute, drink or give away any distilled, spirituous, vinous, fermented, malt or intoxicating liquors in any quantity whatever within any public park acquired by the State under the provisions of this Act, or which may hereafter be acquired, and any person, by himself, agent, or employé, violating the provisions of this section, shall, upon conviction, for the first offense be fined in any sum not less than $25 00 nor exceeding $100.00, and for each subsequent offense be fined not less than $50.00 nor more than $200 00, and imprisoned in the county jail not less than ten days nor more than ninety days. Any shift or device to evade the provisions of this section shall be held to be a violation of this section, and any fine or imprisonment mentioned in this section may be enforced by indictment or information in any court of record having criminal jurisdiction, or the fine mentioned in this section may be sued for and recovered before any justice of the peace in the proper county, in the name of the people of the State of Illinois, and in case of conviction the offender or offenders shall stand committed to the county jail until the judgment and costs are fully paid.

§ 9. The superintendent, guardians, custodians and keepers of any State park are hereby vested with police power to enforce the laws of the State of Illinois in all State parks.[1]

The first appropriation consisted of $150,000 and was expended in the purchase of the Walther property and of two additional strips, 315 acres in all. Subsequently additional purchases have been made until virtually all the important scenic features are now included in the park. The grounds were thrown open to the public in the spring of 1912, and in that year the attendance increased to 75,000.[2] The restrictions are most reasonable; campers and picnic parties have free use of the grounds, subject to the regulations of the commission. Concessions are granted, but the visitor is guarded against exploitation. By this act the state of Illinois has fittingly returned its most historic landmark, situated among scenery of rare excellence, to the people of the whole state for their free and perpetual enjoyment.

[1] House Bill No. 390, Illinois General Assembly, 1911

[2] *Report of the State Park Commission*, 1912, pp. 8–9.

PART II

GEOLOGY

By

GILBERT H. CADY

OUTLINE

INTRODUCTION

In the glens, cliffs, and canyons of Starved Rock Park there is a story of fascinating interest. The sandstone from behind its moss- and lichen-covered walls could tell of ages that have gone. The wooded slopes above contain, half hidden in the ferns, fallen leaves, and branches, layers of limestone, clay, and coal. Each change from layer to layer, from sandstone to limestone, limestone to clay, clay to coal, is significant of the passage of time and of many events. Lands have been worn away by the ceaseless attrition of wind, rain, and running water; climate has changed from warm to cold and from dry to moist; glaciers have come and gone; swamps of immense extent have covered the land; countless races have existed, each to live for years that are as but a day in the vast extent of time, and then made way for another equally ephemeral. All these things have taken place and many more equally strange within the time represented by the rocks of the park. Geologic processes have effected these changes, produced and destroyed the strata, bowed up the sandstone and other rock layers, and excavated the valleys and canyons.

The rock formations will prove of interest to some because of the story that they tell; to others they may have intrinsic interest because of their economic value, several of the formations appearing in the park being exploited on a large scale in the Illinois Valley. Near the south bluff line of the valley the bed of coal known as "No. 2" outcrops. This is one of the important coal beds of the state, at present mined chiefly in the La Salle region. Below the coal is an important fire-clay deposit, of especial value in this region because of its proximity to Chicago markets and steel furnaces. The sandstone which forms the cliffs is a source of great quantities of excellent quartz sand. Numerous pits along the north bluff where the sand is being quarried are in sight from the top of Starved Rock. The market for this sand extends from coast to coast, carload shipments of foundry sand being made almost daily to the Pacific shipyards. Much of this sand is also used in the manufacture of glass.

GENERAL RELATIONS

By referring to the geologic map (Fig. 24) the reader will see that the state park lies on the northern border of the Illinois coal basin and but a short distance east of the axis of the La Salle anticline. North of the coal basin the surface rocks below the glacial drift are of Ordovician and Silurian age. These strata are dominated structurally by a low

inclination to the east and west from the axis of uplift which crosses the state from Stephenson to Lawrence counties, passing near Freeport, Oregon, Franklin Grove, and about two miles west of Starved Rock. Because of the good exposures of the rocks near the axis of the fold in La Salle County, especially near La Salle, this uplift is commonly known

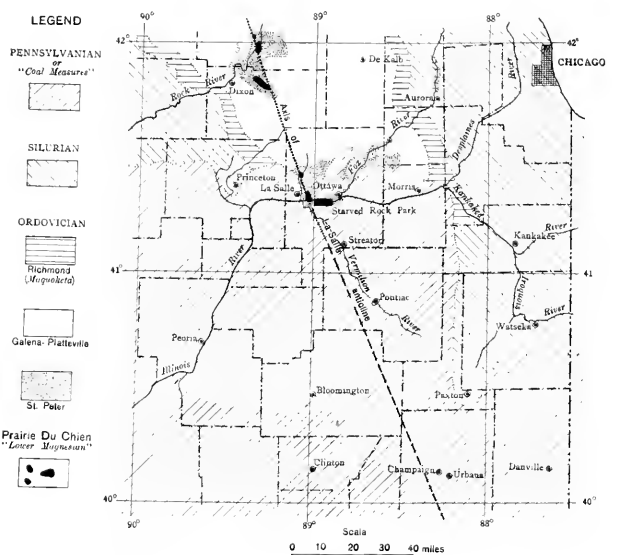


FIG. 24.—Geologic map of north central Illinois, showing the position of the axis of the La Salle anticline and the location of Starved Rock Park.

as the La Salle anticline. Along the axis of the anticline are exposed the oldest rocks of the state, belonging to the Lower Magnesian or Prairie du Chien group (early Ordovician). Because the strata have this anticlinal structure the pattern of the geologic map of Illinois north of the Illinois coal basin shows a north and south alignment of formation boundaries more or less parallel to the axis of deformation.

Within the coal basin the rocks below the glacial drift belong to the Pennsylvanian system or "Coal Measures." These strata dip south

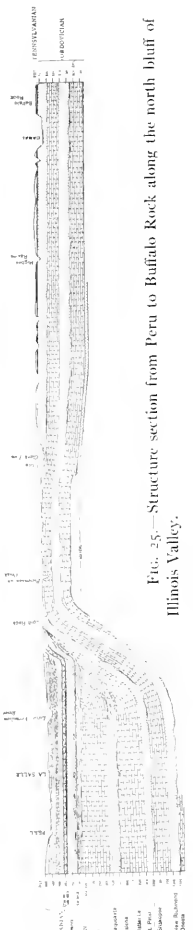


FIG. 25.—Structure section from Peru to Buffalo Rock along the north bluff of Illinois Valley.

toward the center of the basin, so that on the geologic map the northern boundary of the Pennsylvanian rocks extends from east to west, crossing the boundaries and patterns of the older formations. The broad arch or anticline of northern Illinois becomes a much narrower and sharper feature within the coal field. The western limb narrows to one-third of a mile or less in places (Fig. 25) instead of extending halfway across the state, and the east limb possibly does not extend more than twenty-five miles from the crest of the fold. The northern boundary of the Pennsylvanian ("Coal Measures") system shows a conspicuous southward indentation on the geologic map along the axis of the anticline.

On the upland there is, over the stratified rocks of the region, a mantle of glacial drift composed of stony clay, sand, and gravel. The surface configuration of the park is due largely to the drift, and the area partakes of the characteristics of much of the glaciated-plains province in which it lies. Much of Illinois is monotonously level, and except for the valley bottoms the level tracts are of glacial origin and are still much as they were left by the melting glaciers. There are, however, certain belts that rise enough above the general level of their surroundings to be visible for miles. These ridges are *terminal moraines*, marking successive relatively stationary positions of the edge of the ice sheet. In northern Illinois there are three important morainic belts marking three stages of ice advance during the glacial period. The position of these ridges is shown on the map (Fig. 26).

Along the valley between La Salle and Ottawa glacial drift is almost entirely restricted to the uplands back from the edges of the bluffs. The valley has apparently been excavated or

cleaned out down to the level to which the ice worked. Bare rock surfaces are common and glacial drift is almost absent from the valley floor. Late glacial and postglacial waters, including the former outflow from Lake Michigan, have given the valley its present form and aspect. At

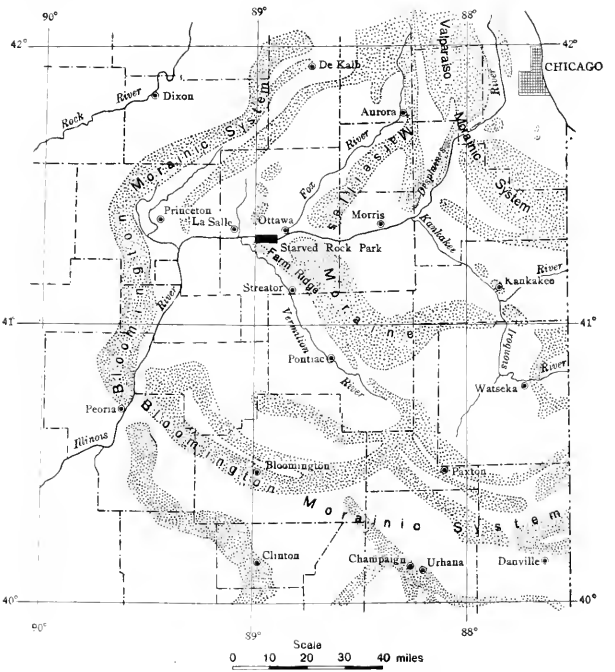


FIG. 26.—Glacial map of northern Illinois (after Leverett, "Illinois Glacial Lobe," *U.S. Geological Survey, Monograph* XXXVIII).

a number of places bordering the upper Illinois Valley, and here and there on the valley floor, are rock and gravel benches, sand bars, and remnants of formerly more extensive surfaces which originated at various times during the excavation of the valley.

Because the valley has been excavated below the general level of the drift the exposures of rock in its walls are excellent. An almost ideal structure section is displayed for several miles above and below Starved Rock, the details of which can almost be followed in panorama from the top of Starved Rock. About 10 miles to the east, $2\frac{1}{2}$ miles above the mouth of the Fox River, the La Salle or No. 2 coal outcrops near the water level of the Illinois. The top of the sandstone formation which forms the cliffs at Starved Rock appears in the bed of the river about $1\frac{1}{2}$ miles downstream below the outcrop of coal. At the mouth of the Fox the surface of the sandstone is about 20 feet above the river and the coal outcrops 5 to 8 feet higher. At Buffalo Rock the top of the sandstone is about 75 feet above the river, and in the bluff south of Starved Rock about 130 feet, the coal farther south being 15 to 20 feet higher. West of Utica on the north side of the river the base of the sandstone is exposed and is sufficiently high above the valley floor so that in places 75 to 80 feet of Lower Magnesian dolomite appears below it in the bluff. Where this rock is exposed much of the overlying sandstone and all the "Coal Measures" strata which once covered the region have been removed. At Split Rock, about 2 miles west of Utica, and at Little Rock, on the south side of the river opposite, the strata dip sharply to the west, a change in the direction of dip having taken place a short distance to the east. The sandstone at Split Rock dips nearly west 25° to 35°, and the "Coal Measures" above, 12° to 15°. This steep inclination continues for about one-fourth mile west, successively younger members of the "Coal Measures" appearing in the valley bluffs. A short distance westward the strata lie horizontally, the La Salle limestone, an important member of the upper part of the Pennsylvanian series, forming conspicuous cliffs along the Illinois and Little and Big Vermilion rivers. Such is the effect of the steep dip along the west limb of the anticline (Fig. 25) that No. 2 coal at La Salle lies about 350 feet and the sandstone about 1,350 below the valley floor.

GEOLOGIC RECORD

PRELIMINARY STATEMENT

The geologic record of Starved Rock Park as read from the rocks is exceedingly fragmentary. The events recorded by the strata exposed or known to underlie this area stand for but a small part of geologic time. The gaps in the record are as important as the parts preserved, for it is known that these gaps are represented elsewhere by thousands of feet of strata. The deposition of the sediments which now constitute the bedded rock of the region doubtless required millions of years.

The gaps in the stratigraphic record are commonly indicated by *unconformable* relations between successive groups of strata. A stratum is said to be *unconformable* above another (1) where there exists a

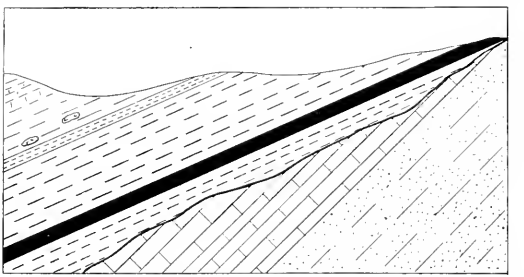


FIG. 27.—Structural unconformity between coal-bearing strata and underlying rocks, as at Split Rock and Deer Park.

discordance in the actual dip of the two strata (Fig. 27), implying that the lower beds were involved in earth movements and suffered erosion before the deposition of the upper; or (2) where the upper stratum rests

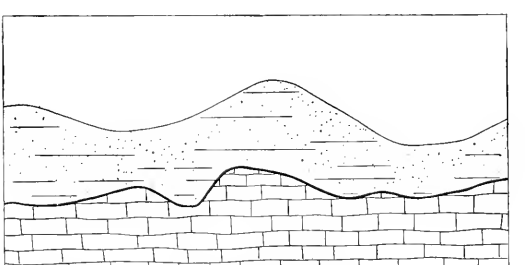


FIG. 28.—Erosional unconformity between sandstone and limestone, as between the St. Peter sandstone and Shakopee dolomite.

on the uneven surface of the lower stratum (Fig. 28), implying that erosion produced the irregularities in the surface of the lower stratum before the deposition of the upper. Unconformities of the first sort are *angular* or *structural unconformities*, those of the second sort *erosional*

unconformities. It may happen that two series of strata appear to be in entire conformity when a study of the fossils contained in them shows a marked difference in the life. This difference is commonly accounted for by assuming an interruption in deposition between the two strata. This stratigraphic relationship has received the name *disconformity*, indicating a hiatus in deposition not marked by structural or erosional unconformity. Unconformities and disconformities are not in themselves time indicators. It is only as the record of the life-development during the time represented by the gap is found in the strata of other regions that the time value of an unconformity can be measured. Unconformities and disconformities are regarded as great when a great length of time is represented by the interval. Between successive strata present within the state park the relations of conformity, disconformity, and unconformity exist. Two of the unconformities at least are of sufficient magnitude to be termed great.

STRATIGRAPHIC SUCCESSION

Table II shows the succession of strata known to underlie the park either from outcrop or from exploration by the drill. The oldest formations are lowest in the table. The position of important unconformities is indicated.

TABLE II

TABLE OF FORMATIONS PRESENT IN STARVED ROCK PARK

Era	System	Series	Group	Formation
Cenozoic	Quaternary	Recent		Late Wisconsin (Marseilles)
		Pleistocene		Early Wisconsin (Bloomington)
		Structural unconformity		
	Pennsylvanian			Carbondale
				Pottsville
		Structural unconformity		
Paleozoic	Ordovician	Middle		Galena (?)
				Platteville (?)
				St. Peter
			Unconformity	
		Lower	Prairie du Chien	*Shakopee*
				New Richmond
				Oneota

Formations the names of which are italicized are known only from drillings in the vicinity of the park.

To show the general relations of the formations listed above a general table of geologic time divisions is presented (Table III). Com-

parison of the two tables shows what a slight portion of the whole section is represented in this region.

TABLE III

GENERAL TABLE OF GEOLOGIC TIME DIVISIONS

Eras	Periods
Cenozoic	Present Pleistocene (At least four and perhaps six glacial stages with interglacial stages) Pliocene Miocene Oligocene Eocene
Mesozoic	Upper Cretaceous Comanchean (Lower Cretaceous) Jurassic Triassic
Paleozoic	Permian Pennsylvanian (Upper Carboniferous) Mississippian (Lower Carboniferous) Devonian Silurian Ordovician Cambrian
Proterozoic	Keweenawan Upper Huronian Middle Huronian Lower Huronian
Archeozoic	Archean complex

The number of formations underlying the park is somewhat less than in adjacent areas. West of the La Salle anticline several formations not present beneath the park have been encountered in drilling, and the glacial succession also is more complete.

DESCRIPTION OF STRATA

STRATA BELOW KNOWN FORMATIONS

The known stratigraphic record of Starved Rock Park belongs to fragments of the later half of geologic time. Concerning the strata laid down in the earlier eras nothing is known except by inference. These early rocks undoubtedly underlie the region as the base on which all the later rocks were deposited, but actual knowledge of the stratigraphic succession in the northern part of Illinois does not extend down to the base of the Paleozoic.

The oldest Paleozoic system is the Cambrian (p. 95). The upper division of this system probably is present beneath the park, as such rocks apparently have been penetrated in wells at Ottawa at a depth of about 1,600 feet.[1]

Formations Known in the Park

ordovician system

Prairie du Chien Group

The known stratigraphic record begins with rocks of the lower part of the Ordovician system belonging to the Prairie du Chien or Lower Magnesian group. The members of this group of strata, which are known only by drilling within the area mapped (Pl. I), are the *Oneota dolomite* at the base; an intermediate sandstone, the *New Richmond;* and the *Shakopee dolomite*, a magnesian limestone, at the top. The group derives its name from Prairie du Chien, Wisconsin, at the junction of the Wisconsin and Mississippi rivers, where its formations are exposed.

The *Oneota formation*, named from Oneota, Minnesota, is not exposed in the state. From drillings it is known to have a thickness of more than 200 feet, and possibly much more, in this part of Illinois. It is composed largely of magnesian limestone or dolomite, but contains some massive sandstone and possibly some shale beds. It is possible that the salt well at Illinois Canyon taps one of the Oneota sandstones, rather than the Cambrian, as previously suggested. A number of wells in this part of the Illinois Valley possibly penetrate the upper dolomitic part of the Oneota at a depth of 375 to 400 feet below the valley bottom. Most of the wells, however, yield an adequate supply of artesian water at a shallower depth. The well at Starved Rock Hotel, which is a typical example of the deeper wells, has a depth of 637 feet. Table IV shows the strata encountered in drilling the well. The record is reproduced graphically in Fig. 29.

The middle member of the Prairie du Chien group is the water-bearing *New Richmond sandstone*, named from New Richmond, Wisconsin. This formation has a thickness of 80 to 90 feet at Ottawa, 136 feet at La Salle, 180 feet at Deer Park, and 190 feet at Starved Rock. The only known exposures of this formation in the state are along Franklin Creek near Franklin Grove, Lee County. The rock is coarse,

[1] It is possible that the water of the salt well north of Illinois (formerly Fishburn) Canyon comes from Cambrian sandstone. A record of this well is not available, but drilling is reported to have stopped at a depth of about 900 feet. Water from the Cambrian rocks in this part of Illinois is not commonly salty.

white sandstone, resembling the St. Peter sandstone, which, however, is finer grained. Locally it appears to contain layers of limestone or dolomite as much as 20 feet thick. This formation is an important

TABLE IV

STRATIGRAPHIC SUCCESSION IN THE ARTESIAN WELL AT STARVED ROCK HOTEL[1]

(Geologic Interpretations by the Writer)

	Thickness in Feet	Depth in Feet
St. Peter sandstone	28	28
Shakopee dolomite	180	208
New Richmond sandstone	100	308
Oneota dolomite (blue limestone)	200	508
Oneota sandstone (white sandstone)	39	637

source of artesian water in the Illinois Valley from Utica to Seneca and in the wells at Deer Park. Part of the water of the Starved Rock well probably is from this source, as is also the water of the artesian wells on various farms along the interurban railway between Starved Rock and Buffalo Rock.

The *Shakopee dolomite*, named from Shakopee, Minnesota, is the upper member of the Prairie du Chien group and underlies the St. Peter sandstone. It is not known to outcrop in the area mapped, but as the top of the formation is very irregular, and as the rock comes to the surface barely one-fourth mile west of the park, and is reported only 28 feet deep at the hotel well, it is not improbable that small areas of the Shakopee now covered or obscured may be discovered within the park. It is probable that the rapids formerly existing in the river at Starved Rock were caused by the Shakopee limestone in the bed of the river, the sanitary district

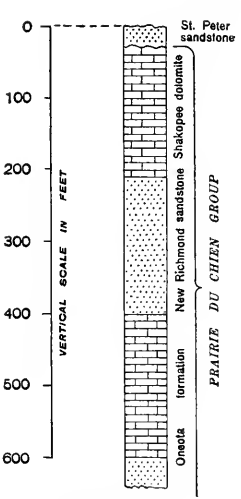


FIG. 29.—Well at Starved Rock Hotel.

[1] A deeper well probably reaching the Cambrian sandstone has since been drilled a few feet southeast of this well.

engineers having indicated the presence of rock (probably Shakopee) in the bed of the river from Delbridge Island to Plum Island. At times of very low water, rock apparently different from the St. Peter was seen along the bank of the river near the mouth of Hidden Canyon. This may be an outcrop of the Shakopee. It is thought probable that the dolomite is not far below the surface of the gravel terrace on the valley bottom north of Starved Rock Lake, at the west end of the park. The numerous springs on the valley floor between Starved Rock and Buffalo Rock and also the spring along the south bank of the river near Wildcat Canyon all possibly indicate the closeness to the surface of the Shakopee from which the water probably is derived.

This formation outcrops in cliffs 50 to 75 feet high along the valley west of Utica nearly to Split Rock and along Pecumsaugan Creek for nearly a mile above the Illinois Valley. The Shakopee also underlies about a square mile of the valley floor west of the Utica road. Its thickness in this region varies from 124 feet at Ottawa to 190 at La Salle. These variations probably are due at least in part to the relief of the upper surface of the dolomite as the result of erosion before the deposition of the St. Peter sandstone above. Some idea of the nature of this old surface can be obtained from an inspection of an exposure of the contact of the dolomite and sandstone in a short ravine on the north side of the valley about midway between Split Rock and Lock 13 on the Illinois and Michigan Canal.

The Shakopee formation is of variable character and contains two beds of compact, finely laminated rock 6 to 14 feet thick, used in the manufacture of hydraulic cement. At one time three large mills manufactured cement in the vicinity of Utica (Fig. 30), but at present only one plant is in operation. Aside from the cement beds the rock is rather open-textured and contains numerous flinty and siliceous masses. Thin sandy beds separate more massive dolomitic strata, and the former are in places ripple-marked, while the dolomite itself is not uncommonly brecciated. The character of the rock suggests that it was deposited in relatively shallow water which at times at least was in active motion and at other times quiet enough to allow fine mud to settle unmixed with coarser material.

St. Peter Sandstone

In strength of physiographic expression and area of outcrop the St. Peter sandstone is the most conspicuous formation in the park. Starved Rock itself is entirely of this formation, as are also the adjacent

cliffs. Practically the entire thickness is exposed in the hill at the west end of the park. The St. Peter sandstone receives its name from the St. Peter (now Minnesota) River of Minnesota, along which it is characteristically exposed. It is a white sandstone, almost pure quartz, the grains of which are well rounded and rather small. Where fresh the rock is commonly rather poorly cemented, but where a surface is exposed the outer layer becomes hardened by the deposition of a cement

FIG. 30.—Lower Magnesian limestone outcropping along the north bluff of Illinois River between Split Rock and Utica.

from the evaporating ground water. The rock is thus enabled to form enduring cliffs, in places having a height of nearly the entire thickness of the formation.

The St. Peter sandstone is thought to have originated as a shore and near-shore deposit, to which both winds and waves had access. Its purity suggests that it suffered much attrition before final burial, whereby material softer than the quartz of which it is so largely composed was removed. Because of its purity and relative weakness as a rock this sandstone is a very important source of high-grade sand for various

purposes, especially for molding and the manufacture of glass. Numerous quarries or "sand pits," as they are called, can be seen from the summit of Starved Rock along the north bluff of the valley. In the vicinity of Ottawa the rock is excavated by hydraulic methods from open pits in the valley floor.

Its unconformable relations with overlying and underlying formations gives the St. Peter sandstone a variable thickness. The unevenness of the surface of the Shakopee dolomite upon which the sandstone rests has been mentioned. This unconformity is probably the source of the greater part of the variation in thickness of the St. Peter formation, the unconformity at the top not being so conspicuous. At Ottawa the sandstone is 130 feet thick; at Starved Rock practically the entire thickness, 145 to 150 feet, is exposed in the south bluff.

The stratigraphic relations with the overlying formations are somewhat unusual. The sandstone within the park is overlain at one place or another by Platteville-Galena dolomite, Pottsville clay, Pleistocene gravel, and alluvium. The relation of the St. Peter and the Platteville-Galena is probably one of unconformity, though this cannot be shown within the park. At Deer Park, however, and along Illinois River east of the mouth of Covel Creek the dolomite or limestone is observed to lie in hollows in the surface of the sandstone, and the relation is one of unconformity (Fig. 31). At Starved Rock the dolomite also seems to lie in a broad, shallow depression in the sandstone, which extends from a point a short distance west of the park to Pontiac Canyon. Where cut across by the Illinois Valley this depression has a depth of possibly 10 to 15 feet, but it probably deepens and widens to the south. On the floor of this depression a small thickness of Platteville-Galena dolomite is preserved below the Pennsylvanian shales. Where the Platteville dolomite is absent, west of the basin, Pennsylvanian or younger formations rest on the St. Peter sandstone, and the relationship is obviously one of unconformity.

Platteville-Galena Dolomite

The known area underlain by Platteville-Galena dolomite is small, being confined to the basin in the surface of the St. Peter sandstone described in the preceding paragraph. The rock outcrops in more or less detached areas in practically all the ravines above the canyons west from Pontiac Canyon. It has not been found east of Pontiac Canyon in this area, but is well exposed along the valley of Covel Creek where it joins the Illinois, and it extends north practically across the entire width

of the valley in a strip nearly one-half mile broad. A limestone phase of this formation is well exposed at the mouth of Deer Park Canyon and in a ravine about 100 feet south. At Deer Park the rock dips about 35° to the west. Slight exposures of westward-dipping Platteville limestone also can be observed near the level of the railroad track for about 150 feet west of the mouth of the tunnel at Split Rock. The Galena dolomite outcrops in the bed and along the banks of the Vermilion River at Lowell. Within the park the Platteville-Galena probably is not more than 10 feet thick. The thickness increases to the south and more than

FIG. 31.—Unconformity between St. Peter sandstone and Platteville-Galena dolomite at Deer Park.

100 feet is present at Lowell. Where the full thickness of the formation is present, west of the anticline at La Salle and Oglesby, the formation has a thickness of about 350 feet.

The Platteville-Galena formation is typically developed in the lead and zinc region of southwestern Wisconsin and northwestern Illinois. Both the Platteville and Galena formations have been identified in the Illinois Valley, the Galena outcropping in the bed of the river at Lowell, and the Platteville beneath is exposed near the mouth of Deer Park Glen at Deer Park. The limestone exposed in some of the side canyons in Starved Rock Park is thought, from its structural relations, to be Platteville, but this is by no means certain, and failure to find fossils makes it advisable to call the strata Platteville-Galena rather than

simply Platteville. It is not improbable that fossils may be discovered in some of the outcrops in the park that will fix the age of the strata, as both formations commonly are fossiliferous.

In the park the Platteville-Galena is a dense flinty dolomite, light gray where fresh, and dark brownish where weathered. The rock contains numerous small crystals of iron pyrites of an olive color, this material probably having come from the surrounding "Coal Measures" clay. The rock outcrops in small patches along the bottom and sides of the gullies west from Pontiac Canyon above the St. Peter sandstone, at an altitude of about 580 feet, and in the floor of the clay pits, especially those west of the park.

The stratigraphic relations of the Platteville-Galena formation with overlying and underlying strata are those of unconformity. The nature of the contact with the underlying St. Peter sandstone has been described. The contact with the Pennsylvanian rocks is clearly one of unconformity, the "Coal Measures" clay lying on the irregular pitted surface of the dolomite, apparently developed by the weathering of the dolomite. The lower part at least of the clay of the "Coal Measures" probably is residual material originating from the decay of the limestone during a time when the limestone was exposed, previous to the Pennsylvanian period.

PENNSYLVANIAN SYSTEM

The Pennsylvanian system ("Coal Measures") of Illinois is divided into three formations: (1) the Pottsville formation at the base; (2) the Carbondale formation (corresponding roughly with the Allegheny series of the East), beginning with No. 2 (La Salle or Third Vein) coal and extending to the top of No. 6 (Herrin, Belleville, or "Blue band") coal; and (3) the McLeansboro formation (corresponding approximately to the Conemaugh series of the East), which includes all strata above No. 6 coal belonging to the Pennsylvanian system. The last two divisions are named from towns in southern Illinois.

The Pottsville formation is without workable coal in most of the state, but the No. 1 coal of Rock Island and Mercer counties is in this formation. The Carbondale formation contains most of the workable coal beds of Illinois, two of which are worked in this region: No. 2 coal (at La Salle and Wilmington) and No. 5 coal (worked in one mine at La Salle, where it is known as the "Second Vein"). Both these beds of coal are worked in some other parts of the state. The McLeansboro formation contains but one workable bed, No. 7 coal (worked at Streator,

Peoria, and Danville). This coal is present at La Salle but is not exploited. It is known locally as the "First Vein." In the La Salle region west of the anticline No. 2, No. 5, and No. 7 coals are believed to be present, but the identification of No. 5 is somewhat uncertain. East of the anticline only No. 2 coal is present, at least as far east as Marseilles. The McLeansboro formation is not definitely known east of the anticline along the valley, though if the upper coal at Marseilles is No. 7 the McLeansboro formation is present there in a small area.

In order to summarize the general relationships of the Pennsylvanian strata in northern Illinois, the following condensed section of the series as developed west of the anticline near La Salle is presented (see Table V; also Fig. 32).

TABLE V

CONDENSED SECTION OF PENNSYLVANIAN SERIES WEST OF LA SALLE ANTICLINE NEAR LA SALLE

	Thickness in Feet	Depth in Feet
McLeansboro formation:		
Shale, clay, thin limestone, and thin coal	70	70
Limestone (La Salle cement rock)	23½	93½
Shale, thin limestone, and thin coal	128½	222
Sandstone and sandy shale	48	270
Shale, black ("black slate")	6	276
Coal, No. 7 (La Salle "First Vein")	4½–5	281
Clay (underclay or fire clay)	6	287
Sandstone and sandy shale	49	336
Carbondale formation:		
Shale, black ("black slate")	10	346
Coal, No. 5 (La Salle "Second Vein"), 3 to 9 feet	6	352
Shale, sandy, and sandstone (Vermilionville sandstone)	69	421
Shale, gray and black ("slate"), thin limestones, and sandstones	68	489
Shale, gray ("soapstone")	15	504
Coal, No. 2 (La Salle "Third Vein"), 3½ to 4 feet	3½	507½
Pottsville formation:		
Clay (underclay or fire clay)	½	508
Sandstone, 3 to 6 feet	3	511
Clay (fire clay)	15	526
Clays and sandstone	60±	586±
Devonian or Silurian system		

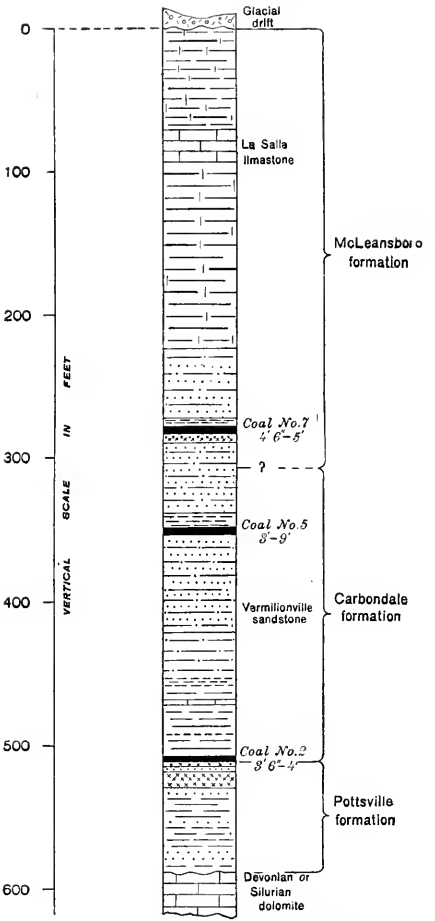


FIG. 32.—Condensed generalized section of "Coal Measures" in the La Salle region.

The Pennsylvanian rocks underlying Starved Rock Park are parts of the Pottsville and Carbondale formations. The section in the park begins above the base of the Vermilionville sandstone, which in the section above is 421 feet below the surface, and ends below with the fire clay shown at a depth of 526 feet in the preceding section. The lower 60 feet, more or less, of clays and sandstones at the base of the Pottsville formation are not present, nor is the 3 to 6 feet of sandstone shown in the generalized section at 511 feet. The upper part of the Pennsylvanian section as originally deposited apparently has been removed. That the corresponding formations are at a much higher elevation in the park than west of La Salle is shown in Fig. 2.

Pottsville Formation

The Pottsville formation is represented (1) by the floor clay or underclay of No. 2 coal and (2) by a body of valuable fire clay lying between this underclay and the surface of the St. Peter sandstone or Platteville-Galena dolomite. The two clays are in contact in the area mapped and are not readily separable, but at Deer Park a sandstone locally 5 or 6 feet in thickness separates them. The clay is being excavated at numerous pits south of the west end of the park and west of the area across the Utica road, whence it is hauled by team or tram to the railroad at Utica. The best exposures of the clay are in these pits. The thickness of the Pottsville formation is variable, due largely to the presence or absence of the lower clay. The area underlain by the lower clay seems to correspond closely to the area underlain by Platteville-Galena dolomite, and it is suspected that it arose from this underlying formation, being a product of its decay. The lower clay is itself of variable thickness because of the irregularities in the floor upon which it lies. The unevenness of this floor can be observed in the pits west of the Utica road. The knobs of Platteville-Galena dolomite present a relief of 3 to 5 feet (Fig. 33) above the depression between.

The Pottsville clay is dark to light drab, structureless, unlaminated, and hence not called shale. Its upper part, the underclay of the coal, is commonly darker than the rest of the deposit. Where the clay has weathered along the natural outcrop it commonly has a yellowish color. The contact of the clay and the dolomite below is in most places marked by a layer of iron sulphide (marcasite or pyrite), not uncommonly associated with crystals of gypsum. The dolomite may also be surrounded by a calcareous deposit 2 to 3 inches in thickness exhibiting radiating structure and apparently composed of a number of closely

fitting cones, hence said to have a "cone-in-cone" structure. In one of the gullies lying between Sac and Kickapoo canyons a large bowlder of what was apparently Platteville-Galena dolomite possessed, instead of this coating of calcareous material with a "cone-in-cone" structure, a calcareous coating composed of small rounded pellets one-eighth to one-fourth inch in diameter, this structure being described as *pisolitic*. The pisolitic rock commonly is found between the upper and lower clay, or possibly at the base of the upper clay where the lower is absent.

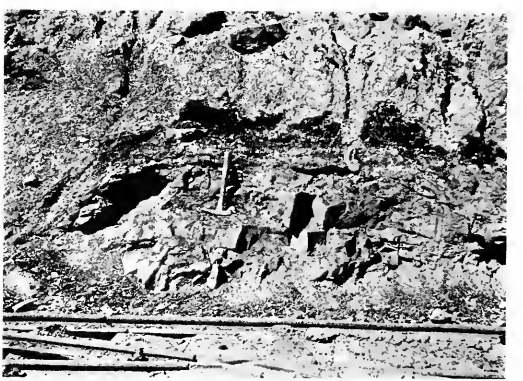


FIG. 33.—Irregular surface of Platteville-Galena dolomite below the "Coal Measures" clay in clay pits west of Starved Rock Park.

Bowlders of pisolitic limestone can be observed lying about 5 feet below the coal in the clay pit along Little Vermilion River north of Deer Park (Illinois Clay Products Company), in which locality they lie between two beds of clay. In the floor of one of the clay pits east of Ottawa near the road bridge over the Illinois and Michigan Canal bowlders of pisolitic limestone apparently lie below the upper clay, possibly none of the lower clay being present. Fig. 34 shows a pisolitic bowlder from one of the clay pits in the southwestern part of the state at what is supposed to be the same horizon in the Pottsville formation. Its duplicate could be found in the La Salle region.

Throughout the clay, especially where it has been exposed for a time, gypsum crystals are rather common. They may lie freely on the

surface in considerable numbers, the oblong, rather flat colorless crystals, isolated or in clusters, being readily recognized, as there is nothing similar with which to confuse them. Where not found on the surface they can generally be found imbedded in the clay. Dr. Joseph E. Pogue has contributed the following explanation showing the relation of the gypsum

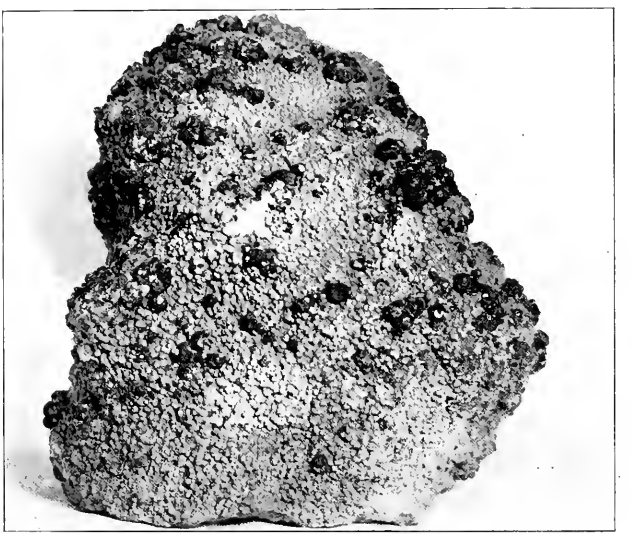


FIG. 34.—Bowlder of pisolitic limestone from the Pottsville formation of southwestern Illinois. Similar to bowlders found in the Starved Rock region.

crystals to the iron sulphide (pyrite or marcasite) crystals, which are also common ingredients of these clays:

The rocks of Pennsylvanian age, the so-called "Coal Measures," exposed in the La Salle district are principally shales carrying a number of coal beds. The La Salle coal includes seams, concretions, and crystals of iron sulphide, which for the most part consist of the mineral marcasite, although some pyrite, of similar composition but different crystallization, is also present. The shales in places, especially where the beds of this rock are exposed on the surface, contain disseminated crystals of gypsum, hydrated sulphate of calcium, which

glisten in the sunlight as the rays are reflected from the crystal facets. There is a significant connection in origin between this colorless gypsum and the brass-yellow marcasite and pyrite.

The iron sulphides, marcasite and pyrite, are commonly present in coal, as well as in shales which carry appreciable organic matter. Their development under these circumstances seems to be due to the action upon iron-bearing solutions of hydrogen sulphide formed by decaying organic matter, and inasmuch as iron is readily leached from rocks in the presence of organic matter, because the latter makes possible the development of soluble iron compounds, coal-forming conditions are favorable to the migration of iron and its deposition in the form of sulphides. This has evidently happened in the "Coal Measures" of La Salle.

At the present time, where these rocks are exposed and are therefore undergoing those processes of weathering which are typified in the chemical change of oxidation, the iron sulphides find conditions uncongenial to their continued existence. Accordingly they take on oxygen, for which iron has such strong affinity, and in this way change to ferrous sulphate and sulphuric acid. These compounds dissolve in the ground water that permeates the rocks, and the sulphate solutions thus produced, active chemically and circulating, react with calcium present in the shales to form the mineral gypsum. This process, wherever conditions were suitable, has developed through the shales the isolated crystals and crystal clusters that may be seen conspicuously in so many places where the rains have washed away the crumbling rock and left these gypsum specimens strewn over the surface.

The economic importance of the Pottsville clays deserves comment. At Utica, Lowell, and Deer Park they are believed to lie at the same horizon as certain important fire clays in southwestern Illinois, outcropping and exploited from place to place from Colchester on the north to Alton on the south. Clays mined at Roodhouse and Whitehall lie at this horizon, and probably also the famous Cheltenham clays of St. Louis. These clays are important sources of raw material for the manufacture of fire brick, pottery, and fireproofing, and the raw clay is much used in the steel industry as furnace lining. The easy accessibility of these clays in the Starved Rock region to the Chicago market gives them an economic advantage over the clays at a greater distance, which fosters their exploitation.

Carbondale Formation

No. 2 coal.—The Carbondale formation begins with No. 2 coal and continues to the top of No. 6 coal. It includes all the Pennsylvanian strata of this area above the Pottsville clays. No. 2 coal is characteristically developed and extensively mined west of the anticline at La Salle,

Oglesby, and Spring Valley. At La Salle and Oglesby it is about 100 feet above sea-level. In the La Salle shaft of the La Salle County Carbon Coal Company, near the Illinois Central depot at La Salle, it is found at a depth of 386 feet. West of the anticline the coal averages $3\frac{1}{2}$ feet in thickness. In Starved Rock Park the coal has an elevation of about 605 feet along the Utica road. On Dimmick Hill, along the state road at the east end of the park, it is about 525 to 530 feet above sea-level, and at Buffalo Rock about 535 feet. In this area the coal is between 2 and 3 feet thick.

Exposures of the coal are numerous. The best are those in the clay pits south and west of the west end of the park and along the road down Dimmick Hill. Natural exposures are to be found along hillsides and in many gullies the entire length of the area. Traces of many old slope mines or "coal diggings" can be found toward the east end of Horseshoe Canyon. No. 2 coal is commonly spoken of as a "long-grain" coal, referring to its habit of breaking in more or less flat slabby fragments parallel to the bedding, as contrasted with the habit of some coals which break in chunks with little reference to bedding. This characteristic, however, is not sufficiently conspicuous, at least to the layman, to serve as a means of identification. The coal, as is characteristic of all Illinois coal, is intimately laminated, the laminae being composed of alternating dull and bright bands. The bright bands are known as "glance" coal. It is commonly supposed that glance coal represents the wood fiber contained in the peat from which the coal was formed.

Impurities in No. 2 coal are rather numerous. The most common impurity is "sulphur." The "sulphur" occurs as streaks or "balls" of mineralized matter, largely iron pyrites or sulphide of iron. These "balls" are rarely more than 3 inches in diameter or the streaks rarely more than a foot in length. Such impurities in coal that is being mined are usually picked out by the miners. This coal rarely contains bedded impurities such as clay or shale. Their absence indicates a long continuance of conditions suitable for the accumulation of peat at the time of its deposition. Practically the only bedded irregularity interrupting the succession of bright and dull laminae are streaks of soft, dirty, or sooty carbonaceous material resembling charcoal, and hence called *mineral charcoal*, and also known as *mother coal*. Such material possibly represents the oxidized portion of the peat from which the coal was formed, the oxidation having taken place at some time when the surface of the peat was uncovered to the sun and air. Toward the west end of the park the coal contains an impurity the occurrence of which seems

to be confined to a small area in this vicinity. Large "bowlders" of calcareous material lie here and there in the coal, in places occupying the whole bed. These masses are 75 per cent or more calcareous material, but are penetrated by coaly matter. They seem to be calcareous petrifications of the coaly material somewhat resembling concretions. Such masses have been observed lying about the pit near the center section 21 south of Kickapoo Canyon. Similar bowlders in the coal have been observed in the vicinity of Deer Park and near Lowell.

Strata above No 2 coal.—There is some variation in the thickness and distribution of the Carbondale strata above No. 2 coal within the area. The attention of the reader is again directed to the fact that these beds dip slightly to the east, so that higher and higher beds are exposed in that direction. The result is that while only about 5 feet of the Carbondale formation is exposed above No. 2 coal at the west end of the park about 75 feet is exposed at the east end. Further, it is important, in order to understand the stratigraphy, to regard this area as transitional between the area west of the anticline and the general area east of the anticline. There is a very typical section in the lower part of the Carbondale formation characteristic of large areas west of the fold, while a different but equally persistent section characterizes large areas east of the fold. The section within the park partakes of the characteristics of both areas, so that stratigraphic sections at localities from Tonti Canyon (or thereabouts) east are different from those farther west

The section (Table VI) of the lower part of the Carbondale formation measured along Vermilion River about a mile below Lowell is representative of the succession in the west part of the park, but only the lower strata are present there.

As representative of the succession to the west the section measured along Covel Creek, about 2 miles east of the area, is presented (Table VII).

Certain members of the sections apparently are continuous from one region to the other: No. 16 in the first section is the same as No. 11 in the second, and No. 14 in the Lowell section is probably the same as No. 8 in the Covel Creek section; No. 6 in the first section is apparently the same as No. 4 in the second, and the coal is the same in both sections. The section measured along Covel Creek corresponds essentially to that outcropping within the area and east of Dimmick Hill along Ottawa, Kaskaskia, Illinois, and Little Horseshoe canyons, but the Vermilionville sandstone appears only at the top of the section in the ravines at the east end of the area, in sec. 30, T. 33 N., R. 3 E.

TABLE VI

SECTION OF THE LOWER PART OF THE CARBONDALE FORMATION ALONG VERMILION RIVER BELOW LOWELL

(See Fig. 35 for Graphic Reproduction)

	Thickness in Feet	Depth in Feet
16. Sandstone (Vermilionville)	25	25
15. Shale, brown siliceous, micaceous	0–15	40
14. Shale, black (black "slate")	2	42
13. Shale, green, blue, and gray	3	45
12. Limestone, impure, fossiliferous	1½	46½
11. Shale, hard, gray	1	47½
10. Shale, hard, calcareous, and carbonaceous; breaks into squarish fragments	3¼	50¾
9. Shale, carbonaceous, resembling cannel coal	¾	51½
8. Shale, black	4½	56
7. Shale, bluish and greenish	12	68
6. Limestone, impure, argillaceous, and sandy	2½	70½
5. Shale, grayish blue, plastic	15	85½
4. Shale, gray, calcareous, and with *septarian* concretions	4	89½
3. Shale, black, fissile (black "slate")	3	92½
2. Shale, gray ("soapstone")	15–18	110½
1. Coal, No. 2	3½	114

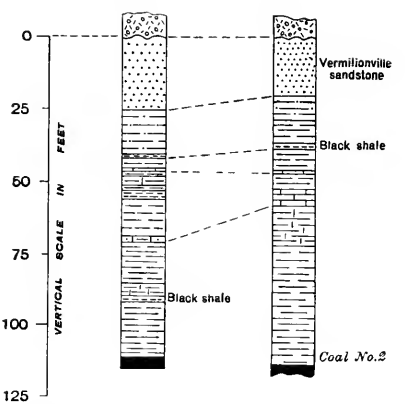


FIG. 35.—Left-hand part, section of the lower part of Carbondale formation along Vermilion River at Lowell. Right-hand part, section of the lower part of Carbondale formation along Covel Creek.

TABLE VII

SECTION OF THE LOWER PART OF THE CARBONDALE FORMATION ALONG COVEL CREEK

	Thickness in Feet	Depth in Feet
11. Sandstone, micaceous (Vermilionville)	20	20
10. Shale, brownish, siliceous	8	28
9. Shale, gray	8	36
8. Shale, black (black "slate")	2	38
7. Shale dark	8	46
6. Limestone	1	47
5. Shale, dark	6	53
4. Limestone, knobby, concretionary, fossiliferous	5	58
3. Shale, gray, with hard layers and streaks of ripple-marked limestone	15	73
2. Shale, gray	40	113
1. Coal, No. 2	$2\frac{1}{2}$	$115\frac{1}{2}$

The members of the lower part of the section as measured along Vermilion River from No. 1 to No. 6 outcrop within the park at least as far east as Tonti Canyon. The gray shale or soapstone, No. 2 of the section, is typically exposed in the clay pits at the west end of the area. The black fissile shale (No. 3) is the uppermost bed of the "Coal Measures" along French Canyon, outcropping near the SE. cor. sec. 21, T. 33 N., R. 2 E., at an altitude of about 620 feet. The same bed is exposed along the road into Tonti Canyon at an altitude of about 605 feet. This black fissile shale (see Fig. 36), locally called "slate," contains numerous large calcareous concretions or "niggerheads" that in places take up nearly the entire thickness of the bed. They are roundish and loosely imbedded in the shale, so that they are common in the bed of the streams along which the shale outcrops. Overlying the black shale is a bed of gray shale (No. 4 of the Vermilion River section) containing another variety of concretions. These are commonly about a foot in diameter and are composed of grayish limestone penetrated by cracks filled with calcite. These concretions have a peculiar appearance, resembling the back of a turtle, and are known as *Septaria*. Toward the east end of the area the black shale and possibly the *septarian* bed seem to change into a gray shale carrying lenses of limestone and possibly corresponding to No. 3 of the Covel Creek section.

The knobby siliceous impure limestone, which forms No. 6 of the Vermilion River section and No. 4 of the Covel Creek section, is exposed

from place to place in the area, as near the head of Wildcat Canyon where the park road turns to the east, along Tonti Canyon in the bed of the ravine at an altitude of about 605 feet, in the bed of La Salle Canyon at about 590 feet, in Hennepin Canyon at about the same altitude, and at slightly lower elevations in practically all the ravines to the east.

In the ravines east of Dimmick Hill the upper black shales or "slates" are exposed, the succession from the siliceous limestone (No. 4 of the Covel Creek section) to the brownish shale (No. 10) being more or less

FIG. 36.—Black fissile shale or "slate" 15 to 18 feet above coal No. 2

irregular in occurrence, but apparently containing two or more beds of black "slate," each of which contains "niggerheads" or concretions similar to those found in the lower black shale (No. 3 of the Vermilion River section). The section exposed down Dimmick Hill begins just below the horizon of the siliceous limestone (No. 4 of the Covel Creek section) and shows the variegated shales lying above No. 2 coal for a thickness of about 45 feet. The section of strata exposed on this hill is shown in Table VIII.

Special attention is called to the relation of the Vermilionville sandstone to the underlying beds of the Carbondale formation. This sandstone appears to lie in a broad depression eroded in the underlying shales. In some places it is entirely absent and in other places it rests on the black shales overlying the siliceous limestone which has received

considerable mention. The sandstone seems to be in the nature of a channel filling of rather limited distribution. It is a fine-grained rock containing many glittering flakes of white mica and in places, at least, a large amount of carbonaceous material. It is not difficult to find in the rock the imprints of the cortex of Carboniferous trees.

TABLE VIII

SECTION AT DIMMICK HILL

NE. ¼ NE. ¼ sec. 25, T. 33 N., R. 2 E.

	Thickness in Feet	Depth in Feet
Loess or clay	2	....
Shale, blue and gray	10	10
Limestone, nodular	2	12
Shale, drab to grayish green	4	16
Shale, dark reddish	1	17
Shale, blue to light gray, with a streak of coal 3 inches from top	4	21
Shale, nodular, locally small masses of limestone	1	22
Shale, light blue or greenish gray	35	57
Coal, No. 2	2½	59½
Shale (fire clay)	3	62½
Sandstone (St. Peter)	90	152½

A considerable thickness of Pennsylvanian rocks has apparently been eroded from the area of the park. It is not improbable that essentially the entire succession exposed on the west limb of the anticline west of Split Rock and near Deer Park once extended over the fold (Fig. 25). The character of these rocks belonging to the upper part of the Carbondale formation and to the McLeansboro formation is shown in the generalized section given on page 103. This succession is well exposed along Vermilion River south of the bridge at the lower entrance to Deer Park. In the bluff above the river as it swings to the north are parts of the Carbondale and McLeansboro formations, the strata dipping to the west at an angle of 12° to 15°. No. 2 coal and the Pottsville clays outcrop in the bed of the river, the direction of outcrop or strike being about parallel with the stream where it flows beneath the bridge. The prominent dark streak in the face of and nearly at the top of the bluff to the south is coal No. 5, or the "Second Vein" of the La Salle field. No. 7 coal is not well exposed, but traces of it can be found in the river bluff, where it has been mined, at the end of a suspension bridge

directly south of the Deer Park station. The La Salle limestone outcrops at the crest of the hill west of Deer Park along the road to Oglesby at an altitude of about 600 feet.

QUATERNARY SYSTEM

Pleistocene Series

The "Coal Measures" strata are overlain by the unconsolidated clays and gravels of the glacial drift, which is much younger than the "Coal Measures." The vast time occupied by the Mesozoic era and the Tertiary periods is entirely unrepresented by deposits in this area.

In Illinois there are deposits representing four or five glacial invasions. Between them there are soils and oxidized zones representing interglacial intervals. In La Salle County there are evidences of the existence of four drift sheets and at least two interglacial deposits or oxidized zones. In Starved Rock Park only two sheets of drift are known, and these are the Early Wisconsin or Bloomington drift sheet and the Late Wisconsin or Marseilles drift sheet. Beneath these two sheets of drift there are in La Salle County two older drifts, representing the deposits of earlier ice sheets. One of these is the Illinoian, and the other is still older. The interglacial deposits known are above and below the Illinoian drift.

Early Wisconsin or Bloomington drift.—It is probable that the principal body of drift in the park belongs to the Bloomington stage of ice advance, but exposures are nowhere very good and determinations are not positive. This drift is of the same general age as all the great body of drift lying at the surface between the Bloomington and the Grand Ridge or Farm Ridge moraines (Fig. 26).

Along the upper Illinois and its tributaries as far east as the Vermilion River the upper till is of pinkish color, rather siliceous, and soft enough to be easily penetrated by pick or trowel. It can be seen in characteristic development along Covel Creek about two miles east of the park and below the Lowell bridge along Vermilion River. A prominent natural cut along the river in sight of and below the bridge shows this upper pinkish drift (or till) near the surface overlying an earlier till of probable Illinoian age.

Within the area of the map pinkish till can be found at the head of gullies at the east end of the park, especially at the head of Illinois Canyon in sec. 30, T. 33 N., R. 3 E. The most easily available exposure, while not within the park, is close to it in the clay pits west of the Utica

road. At times the pits have shown sections with a gray till above a pink till with a thin gravelly deposit between. The pink till is thought to be of Early Wisconsin age, the gray till of Late Wisconsin or Marseilles age (p. 94). The section in one of these pits is shown in Table IX.

TABLE IX

	Thickness in Feet
9. Soil and clay, yellow (loess?)	3
8. Till, gray, upper part oxidized to a brown or yellowish tint	2 to 3
7. Sand and gravel, or a row of pebbles, few inches	
6. Till, pinkish, unoxidized	2 to 5
5. Shale, gray ("soapstone")	0 to 5
4. Coal, No. 2	2+
3. Clay	10
2. Dolomite, Platteville-Galena	+
1. Sandstone, St. Peter	+

In places the pinkish till (No. 6) shows a yellowish oxidized zone 10 inches thick at the top.

Late Wisconsin or Marseilles drift.—Along the Illinois Valley east of Split Rock and Grand Ridge moraine (Fig. 26) there is here and there a thin deposit of sticky gray clay on the upland. In places this clay contains pebbles and has the characteristics of till; in other places it seems to be without stones. This is the upper gray till noted in the foregoing section at the clay pits west of the park. The special characteristics of this till are its gray color and its close, clayey texture. Material similar to this underlies the surface and makes up the great body of the Marseilles moraine. Its extension to the Grand Ridge moraine indicates that this moraine probably represents an advanced position of the Marseilles ice sheet during the Late Wisconsin ice epoch.

Besides the exposures in the clay pits referred to above the gray till may be seen along the park road on the hill east of La Salle Canyon near the SW. cor. sec. 23, T. 33 N., R. 3 E. The gray till has been observed also along Hennepin, Ottawa, Illinois, and Tonti canyons underlying the yellowish silt loam or loess that forms the surface deposit.

Glacial gravels of uncertain age.—In addition to the tills described the glacial drift of the region contains abundant gravel deposits. Where such gravels are found below till of known age the age of the gravel is fixed within certain limits. Where the gravel is found at the surface its age is more difficult to fix, especially when the gravel rests on bed rock. This is the situation with respect to certain gravels found within the area.

The west end of Parkman Plain projecting into Horseshoe Canyon is underlain by a deposit of gravel 25 feet or more thick, so that the top of the sandstone on the east side of the entrance to the canyon is about that distance below the surface of the rock on the west side. The gravel seems to be confined to the east side of the gorge and to continue south a little beyond the end of the lane shown on the map. Exposures are not good, so that it is difficult to determine the constitution of the gravel or to determine certainly whether or not any till is present.

Similar gravel-filled depressions in the surface of the sandstone and near the mouths of large ravines have been found elsewhere in the area. One of these deposits is directly north across the Illinois at the east side of Higbee Canyon and another at the west end of Buffalo Rock. The base of the gravels at these localities is at an elevation between 540 and 550 feet above sea-level, possibly being somewhat lower on Buffalo Rock than at the other two localities. Similar gravels have been found farther west along the side of the valley on the east side of a ravine almost due north of Starved Rock. Here the deposit is seen very definitely to lie against an almost vertical wall of sandstone which probably formed one side of a canyon. The base of this deposit also is between 540 and 550 feet above sea-level. Along Clark Run north of Utica there are a number of similar gravel-filled depressions, the most notable one being about a mile above town, where a gravel-filled gorge cuts across one side of the present canyon, the floor having an altitude of about 560 feet. Along Clark Run there are numerous deposits of gravel in hollows in the sandstone, but in all cases the rock surface seems to be above 550 feet.

East of the park gravel is known to fill a valley, apparently larger than the present valley of the Fox, on the west side of that stream. The base of these gravels is about 530 feet above sea-level. Other gravels are known near the mouth of North Kickapoo Creek between Marseilles and Seneca and also along the south bluff opposite Seneca, the base of the gravel in this latter place being below an altitude of 490 feet. Similar gravels are known in the vicinity of La Salle along Little Vermilion River and at Spring Valley along Spring Creek. All of these gravels are uncemented, unoxidized, of a straw color, and mostly coarse and poorly sorted. It is probable that they are of relatively recent glacial origin and possibly represent ice-margin deposits. These deposits are of special significance as proofs of the existence of a drainage line along the Illinois before their deposition, the floor of which was apparently at an altitude at least as low as 540 feet at Starved Rock, possibly 530 feet or lower at Ottawa, and below 500 feet at Seneca. Whether this valley drained to

the east or to the west is not known. In fact before the late glaciations there may have been valleys draining westward from near the line of the anticline in which the gravels at Spring Valley and La Salle were deposited and other valleys draining eastward from the same divide in which the gravels in the park, at Ottawa, Marseilles, and Seneca were deposited. The discovery by Mr. Carl Sauer of glacial drift in the valley of the Illinois near the Fox River, 30 feet below the known altitude of the rock surface elsewhere, and the occurrence of grooves and striated surfaces on the St. Peter sandstone on the valley floor in the sand pit of the National Plate Glass Company, a mile west of Ottawa, are proof of the existence of a drainage line along the valley previous to the last glacial advance. However, neither the direction of drainage nor the size of the valley has been determined. It is to be regretted that recent excavations have removed the glacial drift and the grooves in the valley floor; but the gravels and the valleys in which they lie still remain as evidence of the drainage line which existed before the last ice advance over the region.

Upland yellow surface clay.—On the upland above the valley, extending back to the flank of the Grand Ridge moraine, the surface material is yellowish, fine-grained, rather closely packed silt loam. It is of the general nature of loess, and probably was mainly deposited by the wind. It seems to be confined to altitudes above 590 feet. Where there are benches at about 580 feet or lower along the edge of the bluff, as between Sac and Fox canyons, this yellow silt loam is absent. Commonly such benches have a covering of recent wind-blown material, whiter in color than the typical silt loam and containing a large percentage of quartz grains evidently derived from the sandstone. The silt loam has a thickness of 2 to 3 feet, and is generally present over the upland. At certain places along the moraine, however, the silt apparently is absent, the gray till extending to the grass roots. In other places where drainage is poor the silt has become so mingled with organic material as to entirely disguise its color and texture, making it difficult if not impossible to recognize. This silt loam is thought to have originated during the glacial period at some time before the surface fronting the ice became covered with vegetation. The immense dusty flats that must have existed at times were the source of the material, and its present distribution and thickness are due partly to original deposition by the wind and partly to redistribution by running water and later winds.

A deposit resembling loess overlies Buffalo Rock. This, however, is much mingled with grains of St. Peter sandstone, so that it is believed

to be of a later origin than the upland silt loam, though it probably contains similar material blown from the uplands.

Gravels of the Chicago outlet.—The Illinois Valley, during the latter part of the Late Wisconsin period of glaciation, served as the outlet of marginal lakes which formed between the ice front and the Valparaiso moraine at the south end of Lake Michigan. During that time a large river flowed through the valley, perhaps covering its bottom from side to side. Here and there on the valley floor, as in the lee of obstructions, gravel deposits were made by the outlet river. At least one such deposit lies within this area at the west end of Buffalo Rock. This deposit is to be distinguished from the higher gravel upon the rock itself, already described (p. 116). The outlet-stream gravel on the valley floor is poorly assorted, warranting no especial description, but the form of the deposit is somewhat interesting, as it displays the features of a typical river bar in its level upper surface and steep downstream termination.

Recent Deposits

Alluvium.—In certain parts of the valley floor there are depressions representing what is believed to be the low places in the channel of the outlet river. The valley floor from a point above Seneca nearly to La Salle is a series of long low steps underlain by successive rock benches. The steps are commonly well marked and extend nearly across the valley. One step in this area extends for nearly a half-mile west in the NE. $\frac{1}{4}$ sec. 22, T. 33 N., R. 2 E., from opposite the mouth of Horseshoe Canyon. The bench of which the step is the termination has an altitude of about 465 feet. North of the bench is a depression, flooded by the high water of 1915–16, which extends east past the middle of Buffalo Rock on the north side. In the vicinity of Buffalo Rock the depression is partly filled by the gravel at the west end of the rock, and is in part occupied by the Illinois and Michigan Canal. The surface of the depression gradually rises until it merges into the general level of a broad bench, which extends from the river to the north bluff in the vicinity of the County Farm at the east end of Buffalo Rock, with an altitude of 466 feet. It is possible that rapids in the outlet river were located at the position of the steps, whereas the deeper, swifter, and smoother current occupied the places where the depressions are now found. The present river has intrenched itself in the old channel floor, and at the time of flood the depressions are the first part of the valley floor to be reached by the high water, the rock benches above rarely if ever being flooded. Recent alluvium and peat are essentially restricted to the lower parts of these depressions. The swampy

area in the N. $\frac{1}{2}$ sec. 30, T. 33 N., R. 3 E., has the same origin as that on the north side of the river. Ancient alluvium and river sand of the outlet river and wind-blown sand cover the higher benches where the rock does not come to the surface.

Dune sand.—Toward the east end of Buffalo Rock there is a small area covered by shifting sand, some of the hills having a distinct dunelike appearance. The material overlying the rock is in part loesslike, possibly derived from the upland silt loam or loess, and in part sand grains, probably derived from the sandstone exposed along the bluffs of the valley and of Buffalo Rock. The rock bench occupying the southern part of sec. 19, T. 33 N., R. 3 E., has a sandy surface, which is also unstable in position.

GEOLOGIC HISTORY

EVENTS DURING THE PALEOZOIC ERA AND EARLIER

The known history of this region begins at a time when the region was the floor of a great shallow sea which covered a large part of the North American continent. On the floor of this sea were accumulating sedimentary deposits which varied from place to place just as marine sediments vary today, but which in this region consisted to a large extent of calcareous material derived mainly from the shells and other secretions of marine invertebrates. This calcareous material now makes up the Oneota formation of the Prairie du Chien group (p. 96). Subsequently sand was deposited on the limestone, forming what is now the New Richmond sandstone. The deposition of this sand was followed by finer sand and limestone material laid down in a shallow sea, the waves of which in places left their impression on the deposits in the form of ripple marks. This deposit now forms the Shakopee dolomite.

Following Shakopee deposition the sea withdrew, leaving a limestone land surface. In this land valleys were carved and erosion and weathering of the rock proceeded until an irregular rock surface covered by a mantle of soil resulted. Again there was an advance of the sea, this time preceded possibly by great masses of white sand washed up by waves and blown inland by winds. This sand, now the St. Peter sandstone, covered the land, protecting the rock below from the waves, so that in places the old soil between the limestone and the St. Peter sandstone is still preserved. After its deposition the sandstone seems to have been, at least locally, above the sea, for when the Platteville limestone was deposited in the sea that occupied this region during middle Ordovician time the surface possessed irregularities which appear to be due to

erosion. The deposition of shells and other calcareous secretions of marine life, which were to make the Platteville-Galena limestone formations, went on for a very long time in a shallow epicontinental sea. After the deposition of the Platteville part of this bifold formation there was probably an interruption in the sedimentation. This is indicated by the fact that the fauna of the Platteville limestone does not change gradually into that of the Galena. The faunas of the two limestones are distinct and the transition types of life which record the transformation of the older faunas into the newer are found in other parts of the world in formations not represented here.

Of the time between the epoch of the Galena limestone and the deposition of the "Coal Measures" there is no record in the park; but from drillings west of the La Salle anticline and from outcrops east toward Joliet it is known that much of Illinois lay below sea-level during parts of late Ordovician, Silurian, and Devonian periods, and also that during considerable parts of each of these periods the region was above the sea. Some time after the deposition of the Galena limestone and before the Pennsylvanian period earth movements developed the La Salle anticline. It is suspected that earlier movements had affected the Lower Magnesian strata before the St. Peter sandstone was deposited, but whether these were restricted to the axis of the La Salle fold is not known. At any rate the older rock along the anticline possesses structures which the younger strata above do not show. The essential outline of the anticline was determined by the movement between middle Ordovician and Pennsylvanian times. The rocks along the axis received about half their present folding at this time, the rocks on the west side of the anticline attaining an inclination of 15° to 25.°

Sufficient time elapsed after this deformation and before the deposition of Pennsylvanian ("Coal Measures") sediments for the development of a nearly level surface of erosion across the deformed beds; in other words, the fold was worn down to approximate flatness. On this flattish surface the sediments which were to make the Pennsylvanian strata were deposited. So level was the land over which the Pottsville (p. 105) sea advanced that erosion was sluggish and the products of rock weathering relatively deep. Over the limestone surfaces, especially, considerable thickness of clay had accumulated, the thickness varying with the depth to which decay had extended. The advancing sea leveled off this mantle of clay until a flat sea floor was produced. Later, when the sea withdrew again plants flourished on a marshy surface. When they died their substance, falling in marshes, underwent but partial decay and became

the peat from which No. 2 coal was developed later. During the rest of the Pennsylvanian period, after the material of No. 2 coal was deposited, there was in this region an alternation of shallow marine and fresh-water, swampy, and land conditions characteristic of that period. There were at least three times when deep peat accumulations were made and a few times when marine limestone was being laid down. With the close of the Pennsylvanian period the marine record of the region was brought to an end.

During the later part of the Pennsylvanian period and during the Permian period which followed there was much crumpling of the rocks near the earth's surface. The eastern mountains in the Allegheny region were folded at this time. It is thought likely that the movement which affected the Pennsylvanian rocks and increased the folding of the older rocks in this region was coincident with the disturbances in the eastern part of the continent. No proofs have been advanced, however, that this was the case.

EVENTS SINCE THE PALEOZOIC ERA

The events of Mesozoic and Tertiary times are essentially unrecorded in this region, or, if recorded, the record is buried, misinterpreted, or unrecognized. In this region the essential evenness in height of the upland surface between preglacial drainage lines, suggests that some time before glaciation, probably in the later part of the Tertiary period, a peneplain had been developed in this part of Illinois. Probably in late Tertiary time there was a general uplift which involved much of the continent. The streams, by reason of the uplift, cut rather deep and finally wide valleys below the peneplain surface. These valleys are now buried beneath the drift and are commonly designated *preglacial valleys*.

The largest and deepest of the preglacial valleys is beneath the drift in Bureau County (Fig. 37). The valley has been traced south from the vicinity of Princeton to the bend of the present Illinois at Bureau, south of which the present valley occupies part of the old valley. North of Princeton the old drainage line has been followed to the north line of Bureau County, where the drift is about 500 feet thick. The valley is thought by some to extend northeastward from this locality and to connect with a buried valley located a short distance west of Rochelle, which in turn has been traced to the Rock River Valley in the vicinity of Byron. There is some reason for thinking that the valley at Princeton connected to the west with the Mississippi along the line of the present valley of

Green River. Whatever the connections were, there is little doubt that a large river occupied a valley which entered Bureau County from the north and extended to the present Illinois Valley south of the bend at Bureau. This valley is commonly designated the Illinois-Rock Valley. The altitude of its channel was at least as low as 325 to 340 feet above sea-level near the bend at Bureau.

Other preglacial valleys (shown in Fig. 37) have been located by drillings and by examining the outcrops along the Illinois and Vermilion rivers. Their relations to one another are largely hypothetical, especially

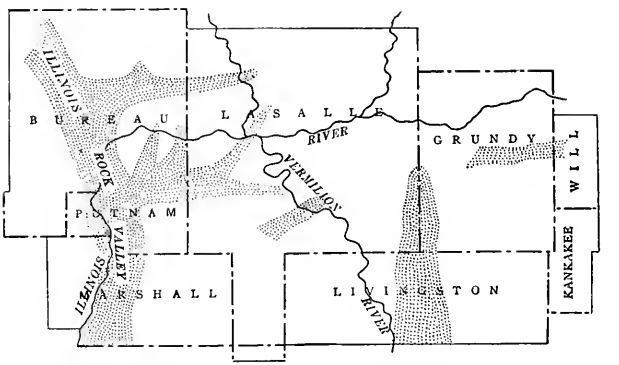


FIG. 37.—Sketch map showing the approximate position of some of the preglacial valleys in the region of Starved Rock.

where drillings are lacking or their records poor. It seems probable, however, that tributaries to the Illinois-Rock joined that river from the east, their valleys extending approximately to the axis of the La Salle anticline. One such valley seems to have existed a short distance south of the upper Illinois and another a short distance to the north, and it is doubtful whether a tributary valley more than two or three miles in length occupied the position of the present Illinois Valley above the bend before the first ice sheet invaded the region.

In addition to the fact that the drainage of the region west of the anticline seems to have been carried away through valleys lying north and south of the position of the present Illinois in preglacial time there

are other reasons for believing that the present valley is not preglacial.[1] Chief among these may be cited: (1) the apparently limited drainage basin available; (2) the apparent difference in the stage of development of such a valley, if one existed within the walls of the present Illinois Valley, and the stage of development of the Illinois-Rock Valley; (3) the apparent existence of an important watershed at about the position of the La Salle anticline, a condition of topography which would be unusual immediately adjacent to a river valley of the age of a preglacial Illinois Valley, if such a valley existed; and finally (4) its course across the anticline would necessitate a rather unusual though by no means unknown relationship of drainage and structure.

East of the anticline there was a well-developed valley in the site of the present valley some time prior to the last ice advance over the region. Deposits of gravel in valleys tributary to this valley before the last glaciation have been described, the deposit at Parkman Plain (p. 117) being an example. The apparent general absence of glacial till beneath these gravels and of oxidized gravel having the appearance of great age leads to the belief that the drainage system of which these valleys were a part existed only in the latter part of the Ice Age, possibly after Illinoian glaciation. Regardless of when it came into existence, the direction of drainage and size of the valley which occupied the site of the present Illinois east of the anticline before Wisconsin glaciation are still uncertain.

In general the present drainage system of the region is thought by the writer to be of post-Bloomington age. The earliest till is located in preglacial valleys, and the preglacial divides and valleys probably held their position after the first glacial period. It is the writer's opinion that the Illinoian ice sheet also left the region with partially filled interglacial valleys and with intervening ridges not deeply covered with drift, and that it was only after the deposition of the early Wisconsin or Bloomington drift sheet that the present system of drainage, which bears no relation to preglacial divides and rock structure, was instituted. Others, however believe that present drainage relations were established earlier, perhaps after the deposition of the Illinoian drift.

The events attending the advance and retreat of the Bloomington ice sheet may be briefly summarized as follows: Interglacial valleys

[1] Distinction must be made between "preglacial" and the time between the first and last glacial epochs. The Wisconsin glacial epoch was much nearer the present time than it was to the first glacial epoch.

were first aggraded by the gravel that preceded the ice, which filled them up to about 600 feet above sea-level. In western La Salle and Bureau counties vegetation that fell and was overwhelmed by the glacial muds is now represented by black peaty beds which are locally the source of gas supplies in Bureau and southern Lee counties. The till was subsequently deposited above the gravel and peaty beds, while the ice stood over the region.

As the ice melted back from its position along the Bloomington moraine the water along its front made its way down the course of the preglacial Illinois and east of the moraine to a depression across the moraine at Peoria. Above Bureau the water in draining from the ice front cut or occupied a valley which followed the "nose" of the ice in its retreat along the line of the present Illinois. If the present upper Illinois Valley is younger than the early Wisconsin ice sheet, the direction of the stream as it issued from the ice front was, it is believed, largely fortuitous, the stream flowing on the drift, above the rock, its course being controlled by the low passageways in the surface of the drift. On the other hand a valley of post-Illinoian and pre-Wisconsin age not completely filled with drift may have guided the post-Bloomington drainage. There was at least one period of ponding of waters in this shallow valley over considerable areas above the bend of the river at Bureau. This is recorded in a bed of silt 15 to 18 inches thick, spread at a uniform elevation over the earlier gravels of the ice advance. Subsequently the outlet was opened and fine gravel was deposited over the surface.

If the waters of the melting Bloomington ice sheet established the course of the upper Illinois Valley, as the writer believes, the valley was interglacial, preceding the last (late Wisconsin) ice invasion. It is impossible to say, however, to what depth the river cut between the periods of early and late Wisconsin glaciation.

Just how far east the ice retreated at this time is not known, but apparently to some line considerably east of Starved Rock. The pink till of the early Wisconsin ice sheet is so conspicuously different from the gray till of the late Wisconsin or Marseilles ice sheet that it seems almost necessary to believe that the latter had advanced from a considerable distance and possibly from a different direction, and that it did not represent simply a readvance of an older ice sheet with the same sort of load.

With the advance of the ice sheet which made the Marseilles moraine the area of the park again was covered with ice. Some time during this

stage of advance the ice apparently extended as far west as the Grand Ridge moraine, the front of the glacier converging toward the valley from the southeast and northeast and crossing the valley possibly between La Salle and Split Rock.

The waters issuing from the ice at Grand Ridge moraine seem to have concentrated toward the valley, especially as the ice melted back from the crest of the ridge. The drift was accordingly washed out as fast as left by the ice, so that on the north side of the valley, especially, there is a general absence of till above the bed rock back of the bluff line, and the bed rock shows evidence of effective water scour, and also possibly some evidence of ice erosion. During and subsequent to the time when the ice stood at the Grand Ridge moraine there was effective erosion down the valley by the abundant glacial waters.

Some time after the retreat from Grand Ridge moraine the ice front stood at the position of Marseilles moraine for a sufficient length of time to build a conspicuous ridge. Bordering this ridge up the valley of the Fox are great quantities of gravel. Toward the Illinois these gravels are less conspicuous, apparently because they were washed down the Illinois by the waters which concentrated in the valley from the north and south along the front of the ice. It is not improbable that the valley for a long distance to the west and extending up to the moraine became filled with the gravel. Conspicuous remnants of this gravel train from the Marseilles ice front are to be seen in the terraces bordering the valley from Hennepin south to Peoria. Later streams which occupied the Illinois Valley seem to have effectively scoured out this gravel from the narrower part of the trench above Bureau.

The ice finally melted back from the moraine at Marseilles, possibly leaving a low place along the line of the Illinois where waters had escaped from the ice front. When the ice entirely melted from the region there remained back of the Marseilles ridge a broad open depression the floor of which was lower than the outlet down the Illinois Valley. In this depression Lake Morris existed temporarily. Probably the clear waters discharging from this lake were effective in clearing out the narrower part of the valley below much of the Marseilles gravel. Eventually the outlet was sufficiently lowered to draw off the waters of the lake.

After its retreat from the Marseilles ridge the ice front stood for a long time at the Valparaiso moraine east of Joliet. The waters from this ice drained down the Des Plaines and Kankakee rivers into the Illinois, the gravel train from this moraine extending, it is said, as far as Morris. The waters beyond continued to be efficient in widening and deepening

the valley and in further clearing out the Marseilles gravel. Later the Illinois became the outlet of the glacial lakes which formed between the ice and Valparaiso moraine at the southern end of Lake Michigan. Great quantities of water seem to have drained along this valley at several times during the various stages of these ice-margin lakes, and they seem to have been very effective in scouring out and in deepening and widening the valley.

The isolation of Starved Rock and Buffalo Rock from the upland and other peculiar features of the valley are believed to date back to a time when the valley was occupied by a large stream, the head of which was much higher than the bottom of the present valley. At this time a depression may have existed south of Starved Rock, between it and the upland to the south. A part of the water of the stream followed this depression and its erosion isolated the two "rocks," making them islands.

When finally the Illinois ceased to be the outlet of Lake Chicago the stream immediately shrank approximately to its present size and occupied only the lowest place in the channel carved by its larger ancestor. Since that time the Illinois above the axis of the anticline has been intrenching itself in the floor of the valley, whereas to the west, where the floor of the outlet river was much lower than to the east, the present river is filling rather than cutting.

After the ice left the region but probably before vegetation had attained a vigorous growth the finer particles of the surface of the drift were moved about considerably by the wind. The effect finally was to produce a covering of rather fine silt which overlies most of the region above the valley. This material ever since its first deposition has been more or less in motion, since it is constantly being carried to lower levels by rain wash, moved about by the winds when dry and not held by vegetation, and subject to many changes in position through the agency of animals and plants. The peat, alluvium, and wind-blown deposits of the valley are obviously of relatively recent origin, having been formed since the river shrunk to its present size.

CONCLUSION

To each lover of nature Starved Rock with its beautiful ravines and canyons tells a different story. The rocks, the shape of the valley, and other geologic phenomena that may be observed afford a foundation of facts upon which the story must be built. But vast eons of time are

represented and much regarding the events that have taken place is left to the imagination. Even those best informed differ in the interpretation of the facts as seen, because rarely are things seen exactly alike. While it is hoped that the main features of the description and history as presented are essentially accurate, it is beyond expectation that the details will meet with the agreement of all. Indeed it is hoped that sufficient interest in the geology of the region will be aroused by the description to foster further investigations and that the result will be a more accurate understanding of the events that have taken place.

PART III

BOTANY

By

HENRY C. COWLES

INTRODUCTION

The state of Illinois, which often is known as the prairie state, has within its boundaries extensive areas of natural forest land. Almost the entire southern portion of the state originally was completely covered with timber. In the northern and central portions of the state there was originally timber in many areas, although perhaps the most typical bird's-eye view must have been that of the prairie. In central and western Illinois particularly the original timber was found mostly along streams. Such a situation essentially is seen in the neighborhood of Starved Rock. A considerable portion of the uplands away from the Illinois River originally was prairie. There is now practically none of this original prairie vegetation left, since the soil has been found to be admirably adapted for agricultural purposes. In striking contrast with the natural upland prairie are the bottom lands of the Illinois River and the adjoining bluffs and canyons. All of this territory was originally covered with heavy timber. Enough of this timber is left to enable us to form a picture of what it must have been. In considering the vegetation of the Starved Rock area it will be convenient to take it up under four heads: the upland oak forest, the canyons, the river bluffs, and the bottom lands.

THE OAK FOREST UPLANDS

At the present time the margin of the upland is more or less covered with oak forest. It may be supposed that originally this oak forest extended farther back than it does at present. Doubtless the farmers who first broke the adjoining land came as near to the edge of the bluff as was practicable, breaking not only prairie land but also some of the oak forest land as well. A large part of the present upland forest area is pastured, so that the original vegetation has largely been destroyed, except as to the trees. In some places, especially near the Wild Cat and French canyons, the natural undergrowth may still be seen. The prevailing tree species here are the white oak (*Quercus alba*), the red oak (*Q. rubra*), the bur oak (*Q. macrocarpa*), and the black oak (*Q. velutina*). Associated with these frequently is the shagbark hickory (*Carya ovata*), and occasionally some single specimens of other species of trees. As a rule the red oak and white oak, together with the hickory, make up the

dominating element of these upland forests (Figs. 5 and 8, pp. 10 and 13). The bur oak is particularly abundant toward the margins of the prairie. So true is this that one may often determine the approaching prairie edge as he goes through the forest by noting the replacement of red and white oaks by bur oaks. The black oak is particularly characteristic of the more sterile places, such as the drier areas very close to the edge of the bluffs.

No attempt will be made to detail the undergrowth characteristic of the oak forest, partly because it has been so largely destroyed, but also partly because the average visitor to the Starved Rock region is interested mostly in the canyons and the river bluffs. It may be noted, however, that such shrubs as the hazel (*Corylus americana*), the low blueberry (*Vaccinium pennsylvanicum*), and the huckleberry (*Gaylussacia baccata*), and such herbs as the bracken fern (*Pteris aquilina*) and the interrupted fern (*Osmunda Claytoniana*), are rather characteristic of these places.

THE CANYONS

Doubtless the average visitor to Starved Rock is most attracted to the canyons, which are places of great interest and beauty. The lover of plants also finds here much that is interesting and beautiful and is continually impressed with the large number of species found that ordinarily are rare or absent. In a later portion of this section some attention will be paid to the question of the origin of such rare and isolated species. Perhaps the most significant single feature of the plant life of the canyons is the display of the lower forms of plant life, notably liverworts, mosses, and algae. In the wetter places, as at the bases of the walls, and particularly in the places where water drips constantly, one may find a luxuriant growth of green algae and blue-green algae of various species. The liverworts are most abundant toward the bottom of the canyons on the walls that are perennially moist but yet not exposed to the constant flow nor the even drip of water. There are very few places in the United States where the abundance of species and individuals of liverworts equals that of the Starved Rock canyons (Fig. 11, p. 16). Among the more conspicuous liverworts may be noted *Conocephalus*, *Marchantia*, *Pellia*, *Blasia*, *Reboulia*, *Scapania*, and *Anthoceros*. *Conocephalus* perhaps is the most abundant of the above and may readily be identified by the division of the plant body into obvious compartments and also by the rather pleasant resinous odor. *Reboulia* is especially characteristic of the drier but not of the driest portions of

the canyon walls. Very frequently the bases of the walls are completely covered by a pure growth of liverworts of one or more species. Doubtless the great abundance of these plants in the canyons is due in large measure to the highly favorable growth conditions, and especially to the constant supply of moisture, but it is also likely that a large factor in the matter is the relative absence of competition on the part of the larger plants. Very few species of the larger plants are able to grow to advantage on steep rock walls, whether moist or dry. Carpets of various mosses are frequently found on the canyon walls. Some species of mosses are able to grow in places much drier than those frequented by the liverworts.

Since the sandstone of the canyon walls readily breaks up into sand a place suitable for the growth of higher plants is frequently presented. The erosion of the walls also is notably differential, resulting in a series of shelves and recesses. Wherever the sand accumulates to a considerable extent or wherever slight shelves project, various ferns and other shade plants are found in abundance. Several species of ferns are peculiarly characteristic of the shelves of moist canyons. Perhaps the most noteworthy species of this sort is the bulb fern (*Cystopteris bulbifera*), which often forms pure stands of considerable beauty in the moister crevices and recesses of the canyons. This fern is of much interest, since it is distributed largely by means of peculiar bulbs which grow on the back portion of the leaf in summer. These bulbs readily fall off and develop further whenever they happen to find lodgment in a favorable situation. In Illinois, at least, this fern is relatively rare and is practically confined to rock canyons. There are two other ferns of similar habitat, viz., the slender cliff brake (*Cryptogramma Stelleri*) and the walking fern (*Camptosorus rhizophyllus*). Both of these ferns occur near Starved Rock, usually on limestone, but neither of them has been found by the author within the boundaries of the state park. On ledges or at the bottoms of cliffs, where the rocks have broken up into sand to a somewhat greater extent, one may find two other plants which are relatively rare in this portion of Illinois, viz., the wild hydrangea (*Hydrangea arborescens*) and the goatsbeard (*Aruncus sylvester*).

When vertical erosion in the canyons gives way to considerable lateral erosion, so that the vertical walls become transformed into steep or ultimately into gentle slopes, there can be found many species of plants generally characteristic of ravines and moist woods (Figs. 10, 11, 13, 14, 19, on pp. 15, 16, 18, 19, 24 and Fig. 38, on p. 134). Among such plants which are relatively common in Illinois are jack-in-the-pulpit (*Arisaema triphyllum*),

bloodroot (*Sanguinaria*), bellwort (*Uvularia*), trillium, hepatica, bishop's-cap (*Mitella diphylla*), and water leaf (*Hydrophyllum*). Such habitats

FIG. 38.—A fern bank, representative of the luxuriant mesophytic vegetation of the Starved Rock canyons.

are particularly rich in ferns, and all visitors, even those having no particular love for botany or plant life, wonder at the great variety and beauty of the ferns of the Starved Rock canyons (Fig. 11 on p. 16, and

Fig. 38). No attempt will be made here to give a complete list of the ferns, but the following may be noted as especially typical of the canyon slopes: spinulose shield fern (*Aspidium spinulosum*), the marginal shield fern (*A. marginale*), the ostrich fern (*Onoclea Struthiopteris*), the Christmas fern (*Polystichum acrostichoides*), the maidenhair fern (*Adiantum pedatum*), the bladder fern (*Cystopteris fragilis*), the beech fern (*Phegopteris*), and those of the spleenworts (*Asplenium angustifolium*, *A. acrostichoides*, and *A. Filix-femina*). Among the characteristic shrubs of the canyons are the red-berried elder (*Sambucus racemosa*), the pawpaw (*Asimina triloba*), the water beech (*Carpinus caroliniana*), the prickly gooseberry (*Ribes Cynosbati*), the witch-hazel (*Hamamelis virginiana*), the wahoo (*Evonymus atropurpureus*), and the yew (*Taxus canadensis*). The last-named shrub, the yew, is particularly noteworthy because it is a very rare shrub in central Illinois (Fig. 11). It is found very sparingly in the state park and, as will be noted later, is one of the most significant species of the region in a historical sense. The red-berried elder is another noteworthy shrub, relatively rare in Illinois and readily distinguished from the black-berried elder, not only by the color of the berries, but also by the fact that its flower clusters are not flat-topped.

Among the more characteristic trees of the canyon slopes are the sugar maple (*Acer saccharum*) and the linden (*Tilia americana*). Perhaps the most characteristic woody vine of the canyons is the Virginia creeper (*Psedera quinquefolia*). Frequently this species is rooted high up on the canyon walls or even at the extreme top of the wall, making a striking appearance as it hangs down toward the bottom of the canyon. A similar appearance sometimes is presented by the gooseberry, since it also sends down long pendulous shoots when rooted on the higher shelves of the canyon walls.

THE RIVER BLUFFS

Probably the most spectacular features of the region are the isolated crags known as Starved Rock and Lovers' Leap (Figs. 4, 5, and 9, pp. 9, 10, and 14). These rocks, in striking contrast to the canyons, present slopes to the full exposure of the sun and wind. Consequently these slopes are almost always dry and, further, are lacking in the conditions or the kinds of life so characteristic of the canyons. The plants found on the exposed bluffs are the kinds of plants that are found in dry areas, usually in mountains or other rocky regions. Since the bluffs break up so readily into sand, certain portions back of the edge present conditions in some respects comparable to sand-dune areas, so far as the

vegetation types are concerned. One who is familiar with the sand-dune vegetation of Lake Michigan will find here many familiar species. On the most exposed portions of the bluffs one sometimes finds places entirely bare of plants. Usually this is not because no plants can be found that are suited to such places, but rather because the rock erodes away so rapidly that the plants cannot get a ready foothold.

FIG. 39.—The crest of Lover's Leap, showing the white pine in a characteristically xerophytic situation. Note the horizontal roots on the flat-topped sandstone.

On portions of the cliffs which are not subject to extremely rapid erosion, especially such portions as have the sand grains cemented by iron, one may frequently find pioneer lichens of various kinds (as the reindeer lichen, *Cladonia rangiferina*) and also certain mosses that are extremely tolerant of drought. Among such mosses one may frequently note species of the haircap moss (*Polytrichum*). In places almost as dry one may find a very interesting mosslike fern (*Selaginella rupestris*), a species that is relatively rare in Illinois. In the crevices and recesses of the rock one may occasionally find two other ferns rare in this state, viz., *Woodsia Ilvensis* and the cliff brake (*Pellaea atropurpurea*). In

places not quite so dry there is still another fern, *Polypodium vulgare*. The occurrence here of the cliff brake is especially noteworthy since it is a fern that is generally regarded as confined to limestone. Other herbs that are especially characteristic of the bluffs are the harebell (*Campanula rotundifolia*), *Houstonia purpurea*, the blue toadflax (*Linaria canadensis*), the lousewort (*Pedicularis canadensis*), the western wallflower (*Erysimum*), the birdfoot violet (*Viola pedata*), *Cerastium arvense*, and *Baptisia bracteata*. Several shrubs occur on the drier portions of the bluffs, viz., the dwarf juneberry (*Amelanchier*), the chokeberry (*Pyrus melanocarpa*), the huckleberry (*Gaylussacia baccata*), the common low blueberry (*Vaccinium pennsylvanicum*), the Canada blueberry (*V. canadense*), the ninebark (*Physocarpus opulifolius*), and the bush honeysuckle (*Diervilla Lonicera*). Three species of evergreen trees (Figs. 6, 9, pp. 11, 14, and Fig. 39) are especially characteristic of the bluffs, viz., the white pine (*Pinus Strobus*), the arbor vitae (*Thuya occidentalis*), and the red cedar (*Juniperus virginiana*).

A somewhat surprising feature of the bluffs is the presence in dry exposed situations of a number of plants, especially shrubs, common also to swamps and bogs. At first the presence of the same species in two such different habitats was very difficult to explain, but recent investigations have shown that the conditions for the absorption of water in many bogs are hardly less favorable than on dry rocks. Among the plants that may be noted as common to such apparently diverse habitats are the chokeberry, huckleberry, juneberry, arbor vitae, and white pine. Other characteristic bog plants found also on the Starved Rock bluffs are the cinnamon fern (*Osmunda cinnamomea*), the winter berry (*Ilex verticillata*), the mountain holly (*Nemopanthus mucronata*), the swamp saxifrage (*Saxifraga pennsylvanica*), and the water horehound (*Lycopus*). Most of the latter species, as well as most of the preceding species in the list of bluff plants, have various means whereby the rapid loss of water through transpiration is very greatly diminished. For example, they contrast strikingly with the plants of the canyons in having such features as abundance of hairs, thick skins, small size, reduced surface of plant body, compact growth, etc.

THE BOTTOM LANDS

Much less than the canyons and the bluffs do the bottom lands at the present time show conspicuous examples of natural vegetation, inasmuch as they are highly desirable for agricultural purposes. Perhaps no lands in Illinois are more suitable for luxuriant crops of corn than are

these lands subject to periodic overflow. Only on the margins of the bottom lands (Fig. 2, p. 7) or on small islands (Fig. 40) in the river may one get a picture of the luxuriant natural vegetation that once covered the flood-plain of the Illinois River. On the margins of the islands, and of the bottom land generally, where the overflow by the river is a regularly recurring phenomenon, one finds as a rule representatives of two kinds of plants: first, amphibious swamp plants that are readily able to withstand submergence or emergence, and second, short-lived annuals that

FIG. 40.—A recently developed island in the Illinois River, near Starved Rock. The pointed end with the younger growth is the downstream end.

spring into existence in late spring, after the freshets have subsided. Among the characteristic swamp perennials are various species of cress (*Radicula*) and dock (*Rumex*). Among the short-lived annuals may be noted the giant ragweed (*Ambrosia trifida*) and the cocklebur (*Xanthium*). The giant ragweed is particularly striking in view of its rapid and luxuriant growth. Probably no other native plant in our climate is able to grow to such a height within the limits of a single short season. One frequently finds specimens on the rich bottom lands of this gigantic herb extending to a height of fifteen to twenty feet, forming a dense miniature forest.

On the edge of the flood-plain there are certain characteristic shrubs and trees, among which the willows are most conspicuous, particularly

Salix fluviatilis and *S. nigra*. These willows frequently form a fringe, giving material aid in the protection of the bottom lands from erosion. Back of the willows one finds such characteristic bottom land trees as box elder (*Acer Negundo*), the river maple (*A. saccharinum*), the walnut (*Juglans nigra*), hackberry (*Celtis occidentalis*), the white ash (*Fraxinus americana*), and the cottonwood (*Populus deltoides*). On somewhat drier places are found the following trees, relatively rare in most parts of northern Illinois: The Kentucky coffee-tree (*Gymnocladus canadensis*), the honey locust (*Gleditsia triacanthos*), and the redbud (*Cercis canadensis*).

THE HISTORY OF THE STARVED ROCK VEGETATION

I. ANCIENT HISTORY

For our present purpose it is not necessary to consider conditions previous to the Pleistocene Ice Age. When the ice overspread northern Illinois it is obvious that vegetation such as the present could not have existed in the Starved Rock region. We may imagine that the species now present there could at that time have been found in the southern United States. Following the last retreat of the glacial ice we have reason to believe that the vegetation gradually migrated northward. It is probable that the first vegetation to inhabit the bare lands after the retreat of the ice from the Starved Rock region was a vegetation comparable to that now found in the tundras of Labrador and the Hudson Bay region. There still remain species which may possibly be relics of that far-off time. Notable among these are the harebell and the reindeer lichen.

Following the tundra there probably came an epoch characterized by the dominance of species now characteristic of the conifer region of Quebec and Lake Superior. Several species of this time still remain, notable among them being the Canada blueberry and the bunchberry (*Cornus canadensis*). Following the conifers there probably came into the Starved Rock region a vegetation comparable to that of the present time in northern Michigan and Wisconsin, that is, a vegetation of considerable luxuriance and suited to a climate milder than that of the previous conifer period, and at the same time considerably moister than the period of the present time. Among the relics of this relatively recent period may be noted the white pine (Figs. 6, 9, 39, pp. 11, 14, and 136), arbor vitae, chokeberry, mountain holly, Woodsia, Selaginella, marginal shield fern, and yew. In more recent times this vegetation

has become greatly diminished in the Starved Rock region and has become extinct in most parts of northern Illinois.

The relic species are in part found in the canyons, as is the case with the yew and the shield fern, and are in part characteristic of the river bluffs. It might be supposed that these northern species, if they are characteristic of a climate moister than the present, would hardly be found in abundance on the river bluffs and would be expected mostly in the canyons. It must be borne in mind, however, that another factor than diminishing moisture is responsible for the elimination of northern species, and that is the increasing competition which these plants have been forced to undergo on account of the migration in modern times of many species from the South. There are at present in the Starved Rock region many plants which reach their approximate northern limit there, and which may be imagined to have been a part of this immigrating flora from the South that has competed with, and to a large extent eliminated, the diminishing northern flora. Among the most important of these southern species are the hackberry, Kentucky coffee-tree, honey locust, redbud, pawpaw, and Houstonia.

II. PRESENT-DAY CHANGES IN THE VEGETATION

We may imagine that the immigration of plants from the South and the elimination of the receding northern plants is still continuing. At least there is no reason why this process should as yet have reached its conclusion, inasmuch as we know that many species have not as yet reached their extreme limits of possible growth under present-day conditions. For example, the Osage orange is perfectly hardy in northern Illinois but as yet has not reached in its northward migration beyond Arkansas and Mississippi. Such migrations as are here noted are generally too slow to be brought under survey by human observation, and we depend for our knowledge of such processes mostly upon data obtained from fossils.

Certain changes, however, are taking place at the present time and in such a rapid way that their study is by no means difficult. Perhaps the most conspicuous example of such a phenomenon in the Starved Rock region is the change in the flora of the river islands. Very casual observation brings to view the fact that the river each year is adding material to the upgrowth of these islands, especially at the lower ends. As new areas are year by year developed in this way it is obvious that new places become available for plant growth. The older parts of the islands are also being constantly built up, and therefore new plants suited to

somewhat drier situations may replace the pioneers here. Consequently we find a succession of forms inhabiting such places, the pioneers on the newer parts of the islands being such swamp perennials and ephemeral annuals as were noted in a preceding paragraph (Fig. 40). As the alluvium increases to such an amount that the portions once submerged for most of the year become largely free from submergence, even in the freshets of spring, vegetation of quite another character may develop on the flood-plains and eliminate the pioneer swamp perennials and ephemeral annuals. Hence we see a constant invasion of the pioneer areas by the trees and other plants characteristic of the mature bottom lands.

Similarly, but less conspicuously, we find evidence of change going on both on the river bluffs and in the canyons. Certain portions of the bluffs are subject to constant erosion and there, of course, very little in the way of plant life is to be expected. On other and more stable portions one may find evidences of pioneer vegetation in the form of lichens, which may give way to mosses and eventually to herbs and shrubs. This succession ultimately culminates in a forest, which in the Starved Rock region usually is of the upland oak forest type previously considered (Fig. 8, p. 13). In the canyons one finds evidence of gradual widening, and hence increasing exposure, resulting oftentimes in the slow elimination of the characteristic canyon species. One also finds evidences of transformation of vertical rock walls into steep soil slopes. This change also results in the transformation of plant life, the pioneer liverworts and mosses in such places being obliged to give way to the ferns, herbs, and trees characteristic of the gentle canyon slopes.

One may perhaps look ahead to some future time when the continuing processes of erosion will eliminate the canyons and the bluffs, their place being taken by areas more comparable to the present flood-plain, or at least to relatively plane lands on which the vegetation, of course, would be utterly different from that now found in the canyons and on the bluffs. Probably long before that time shall come we may anticipate that the relic northern species which now add so largely to the beauty and interest of the canyons and the bluffs will have been eliminated, largely through competition with the more successful migrating species from the South. Humanly speaking, however, we may expect that many centuries will elapse before these interesting species have disappeared. Particularly is this the case since the area has now, fortunately, been made a state reservation.

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